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- Environmental issues in estate planning
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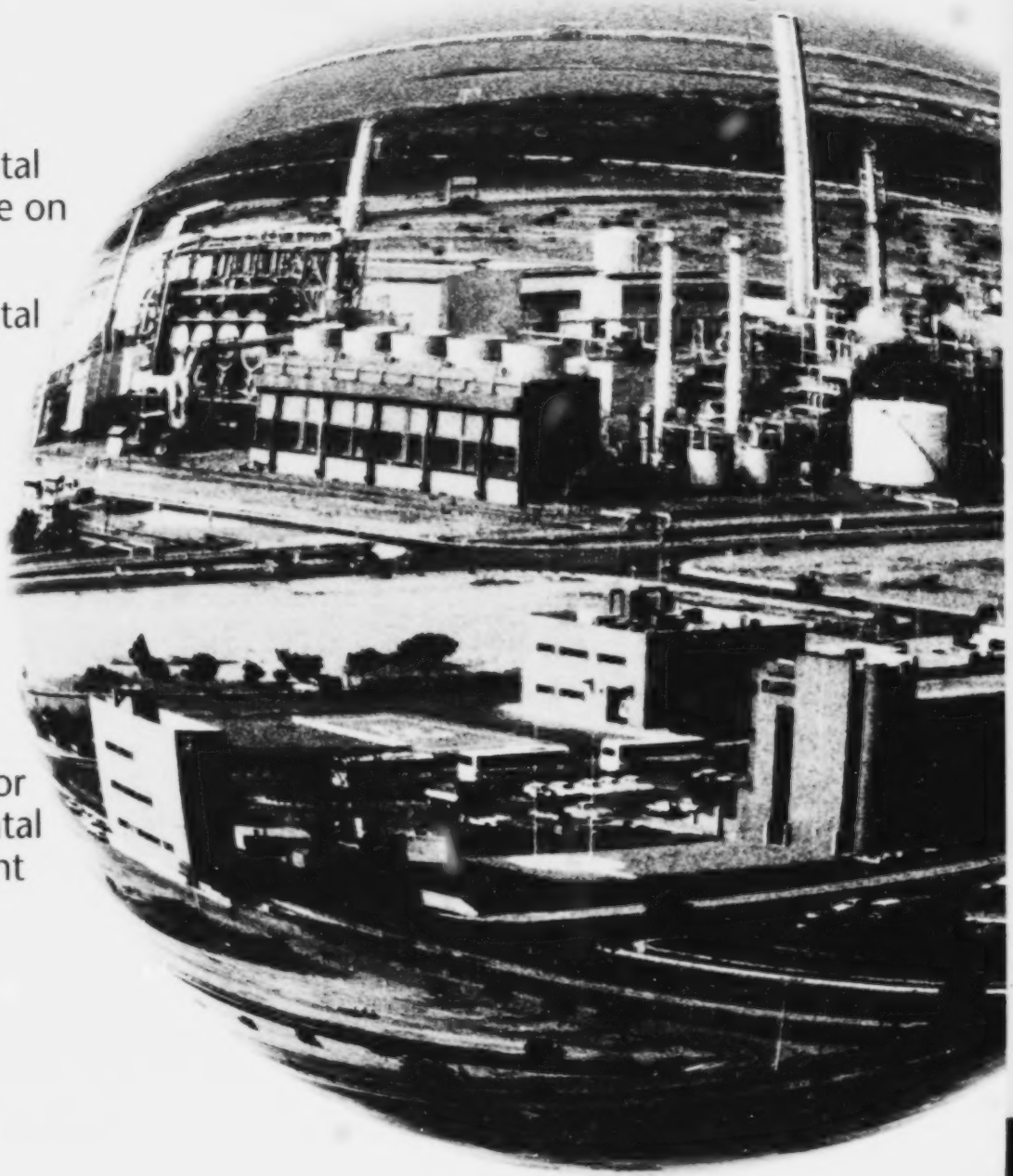

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Editorial

Environmental management and industrial estates: an opportunity for sustainable development

The concept of the "industrial estate" emerged in industrialized countries towards the end of the nineteenth century, as a means to promote, plan and manage industrial development. Since the 1970s, there has been a massive increase in the number of estates worldwide, especially in the rapidly industrializing countries. There are now more than 12,000 of these estates in the world. They vary widely in age, size, type and organization, but they do have essential common elements: an industrial estate is a cluster of industries within a defined geographical area, administered and/or managed by a single authority having a defined jurisdiction with respect to tenant companies. Alternative terms often used are industrial parks, zones or districts.

As an effective instrument for industrial development – reducing costs of infrastructure and stimulating regional economic activities – industrial estates provide benefits to communities, but they can also lead to environmental, health and safety problems. At present, most estates are planned and operated with little concern for their environmental impacts and are causing significant environmental damage in many areas. The main issues of concern are: habitat destruction, loss of biodiversity, air emissions, effluents, solid wastes, hazardous wastes, noise/radiation, toxic chemicals, soil contamination, industrial accidents, chemical and fuel spills, and global climate change.

Environmental impacts of estates arise from two distinct phases: planning and operation. When planning industrial estates, developers typically look at land use and development from a purely marketing and engineering point of view. With this approach, in which cost-effectiveness is the overriding criterion, precious environmental resources are often disregarded. Many industrial estates are located in environmentally sensitive, low-lying wetlands close to coasts. Failure to consider environmental issues when selecting sites can, therefore, result in irrevocable environmental damage including loss of rare habitat and subsequent pollution of coastal waters. And the effects of unsatisfactory site selection extend beyond the boundaries of the site itself. Drainage and infrastructure work associated with the building of an estate frequently interferes with the hydrology and ecology of neighbouring areas. Growth of industrial estates is also often accompanied by unplanned population movements, mainly of migrant workers requiring shelter and essential services. Such movements can cause public health problems, additional environmental stress, and social dislocation.

In the operating phase, poorly managed concentrations of industries are sources of air and water pollution, and of traffic congestion and noise, and pose a threat of industrial accidents. The fact that industries are concentrated – hundreds of small, medium-sized and large companies may be located on the big estates – can give rise to cumulative impacts resulting from the many emissions to air, water and land. If several industries close to one another use chemicals, these may interact or mix, with possible cumulative or synergistic effects on the local environment and neighbouring communities.

With such a potential for damage from concentrations of industries, there is a clear need for environmental management within industrial estates. On the other hand, the very proximity of these industries, which causes environmental damage, can be turned to advantage in the search for solutions. Estates can be centrally controlled and managed at all stages of their existence, and this creates opportunities for coordinated and coherent application of environmental management principles. Until recently, however, the focus for development of explicit environmental management systems has been the individual company. If such systems are to be applied to industrial estates, they will need to be adapted. An estate is in essence a community, and estate managers must find ways to balance individual company and community interests when implementing environmental management. There is a need for clear definition of responsibilities and accountability regarding environmental issues, specifying which aspects are the responsibilities of the local community or of government agencies, and which are to be controlled at estate and individual company levels.

Increased awareness of environmental issues and increasingly stringent regulations are now pushing estates to look for cost-effective ways to improve their environmental performance. There is a window of opportunity here. Many small and medium-sized companies, especially in developing countries, cannot afford to design, build and operate their own pollution control systems. For such companies, environmental compliance problems could be handled more easily, and more cost-effectively, by locating in appropriately managed industrial estates. With the emergence of new standards, such as the ISO 14000 series, estates offering advice and services to companies to help them comply will be able to use implementation of environmental management principles as a trump card to attract them. Profitability can be linked to environmental protection in a "win-win" situation, for the individual company, for the estate and, ultimately, for the environment. Integration of environmental concerns into the management of industrial estates is likely to become an increasingly important factor in attracting and retaining tenant companies. In this context, environmental management specifically tailored to the needs of estates will make an important contribution to sustainable development.

With properly defined and well structured environmental management, many opportunities exist to develop and operate industrial estates in a more sustainable manner. If environmental concerns are integrated into estate development at all stages, cumulative damaging effects can be avoided. For example, permits can be granted so as to ensure that only compatible industries are allowed to locate in a given area. In fact, solutions lie along a continuum, ranging from provision of a minimum of services, such as centralized waste disposal and sewage systems, to more comprehensive approaches in which estates are properly planned and then operated by authorities who can give advice on, for example, energy efficiency, resource conservation and waste minimization, cleaner production information centres, and preparedness and planning for accidents. At the far end of the continuum are industrial estates designed as "industrial ecosystems". This issue of *Industry and Environment* gives examples of current practices in a number of countries and presents some of the more theoretical work from the emerging field of industrial ecology. UNEP will also be publishing a *Guide to Environemental Management of Industrial Estates* later this year to help decision makers in government and industry better design and operate their estates. ◆

Industrial estates worldwide: facts and figures

Regardless of the term applied – industrial estate, industrial zone or industrial district – the concept of concentrations of industries as a strategic element in development planning is used in many countries. The advantages of this concept can be summed up as follows:

- The problem of zoning is minimized by grouping various types of industrial activities.
- Costs of infrastructure and utilities are reduced by concentrating activities in planned areas.
- Complementary industries and services can have multiplier effects on the surrounding region and thus stimulate further economic development.
- When properly planned, industrial estates provide the means of decentralizing industries, thus accelerating regional development.

At present the trend towards industrial estates is continuing in both developed and developing countries, but it is far stronger where there is rapid industrialization. There is also a tendency to group activities other than the traditional industrial ones. This is leading to the development of a wide variety of types of estates, including office estates, research parks, air-, water- and rail-oriented estates, and new town estates. Estates therefore vary widely in age, size, type, purpose and organization and this has led to a profusion of terms being used to describe them. The most important of these are defined in **Box 1**.

No exact figure can be put on the number of industrial estates in the world today, but a best estimate puts it at between 12,000 and 20,000 and rising. A survey of estates of various types, carried out by the International Development Research Council (IRDC) lists some 12,600 estates in 90 countries. In the developed countries there are around 8,800 in the US; 1,200 in Canada; 200 in the UK; 300 in Germany; and 130 in the Netherlands. The survey also shows that 60 per cent of these are privately owned.

Figures for member countries of the Association of Southeast Asian Nations (ASEAN) show that although development in Asia began much later, industrial estates are growing rapidly. India was the first country to incorporate the concept into its industrial planning policies, in the 1950s. There was then rapid and widespread development in Asia during the 1960s and 1970s, as its exports of manufactured goods grew. A report for the United Nations Centre for Regional Development, published in 1993, recorded 19 estates in Indonesia, more than 150 in Malaysia and more than 600 in Japan. A more recent figure for Indonesia shows about 80 estates in the process of development or already operating. In Thailand there are 23 estates, occupying some 22,000 acres and providing employment for over 170,000 people.

Box 1
Definitions of terms related to industrial estates

Industrial estate: a defined geographical area which contains businesses of an industrial nature. These businesses may be similar or diverse, light or heavy, up-to-date or relatively unsophisticated, etc., but the essential element is that the estate is administered/managed by a single authority that has defined jurisdiction with respect to tenant companies. The authority makes provision for continuing management, enforcing restrictions on tenants and detailed planning with respect to lot sizes, access and utilities, etc. – definition based on *Environmental Management of Industrial Estates*, a forthcoming UNEP IE Technical Report.

Industrial district: an area in which a group of related industrial firms (often including small ones) are located. They may have developed strong relations among themselves and this may have fostered innovation and contributed to higher efficiency.

Industrial park: an area which contains several businesses of an industrial nature. These industries may be similar or diverse, light or heavy, up-to-date or relatively unsophisticated, etc., but they will usually be small or medium-sized.

Industrial zones: an area reserved for industrial use.

Business park: an area which contains several businesses of a commercial nature. It is generally more service than manufacturing oriented.

Eco-park: such an area constructed along ecological lines. It may also focus on attracting environmental service companies.

Environmental impacts from industrial estates can be severe, on both local and global levels. **Figure 1** shows examples of local impacts which can result from activities within an estate. In addition to the problems illustrated, estates also concentrate the risks associated with changes in land use, industrial pollution, and marine and other forms of transport and have implications for global issues such as climate change and biodiversity.

Many industrial estates have grown up around ports. This is a common pattern throughout the world which causes specific problems of pollution of coastal and international waters. Environmental impacts include discharge of high levels of organic pollutants and heavy metals into coastal waters, potentially hazardous situations arising from shipping accidents, handling of dangerous goods, and fires and explosions in such environmentally sensitive areas. Dredging operations in ports also produce very large amounts of sludge. Satisfactory disposal of sludge is a major problem in certain ports. Rotterdam is a well known example.

The largest industrial estate in the world, the Jebel Ali Free Zone in Dubai, is an example of an estate in a port area where considerable efforts have been made to address environmental risk. In 1995 there were 793 companies located in this estate. These were zoned according to type of industry, such as oil-related, chemical, heavy, light, servicing workshops, warehouses, etc. The responsible authority set up an Operations Control Department which has developed manuals for health and safety standards and for environmental control requirements within the estate. The department also carries out environmental reviews and has its own laboratory to monitor the quality of the air and of effluent from sewage treatment plants. The sewage treatment plants are operated by the department; companies must undertake to treat their own industrial effluent. Additional advice is available to companies on cleaner production and recycling opportunities.

Jebel Ali is, unfortunately, an exception. Surveys by UNEP have found that few estates have an explicit environmental management capability or any environmental plan at estate level at present. However, under the combined influence of increased awareness of environmental issues and more stringent regulations, estates are being obliged to look for cost-effective ways of improving their environmental performance. This means implementing an Environmental Management System (EMS) at estate level. However, while this can be a highly effective way of improving environmental performance, such systems still generally view economic activity as an open system in which raw materials are drawn in from the environment and large amounts of unwanted by-products are discharged in the form of waste. Alternative models are now being proposed from the field of industrial ecology. The industrial ecologist views the the economy as a closed system, similar to a natural ecosystem, in which the "waste" products from one system element are the "nutrients" for another. The differences between

Figure 1
Typical impacts from an industrial estate

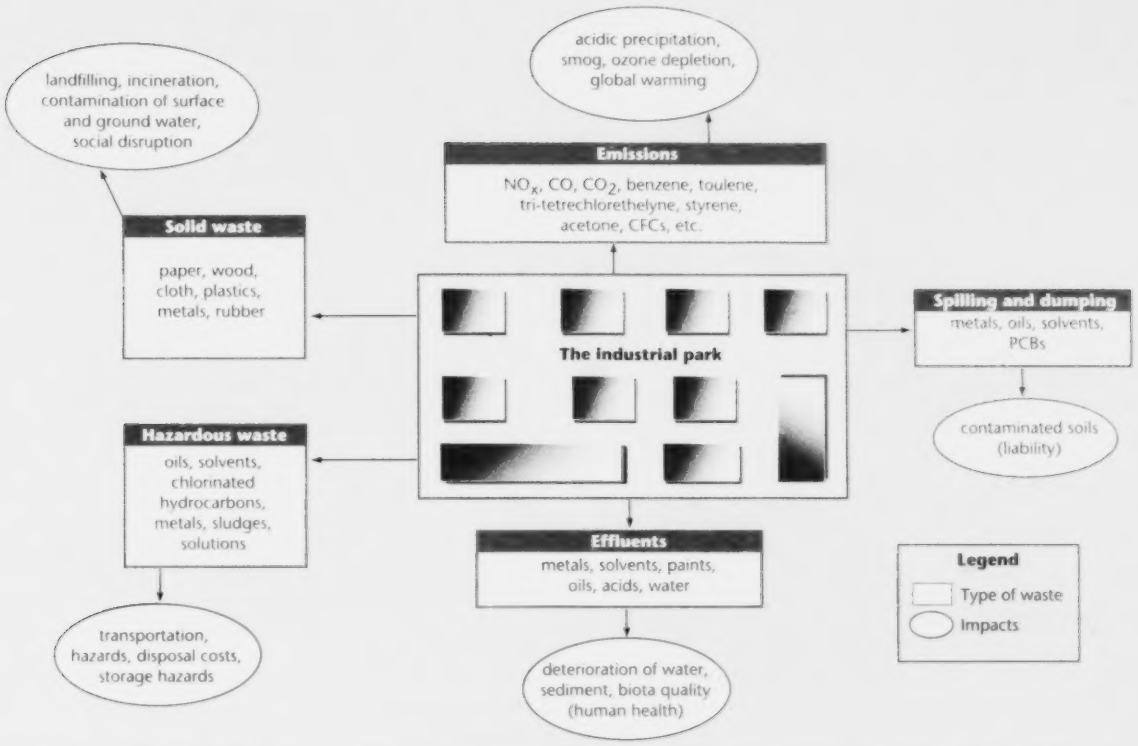
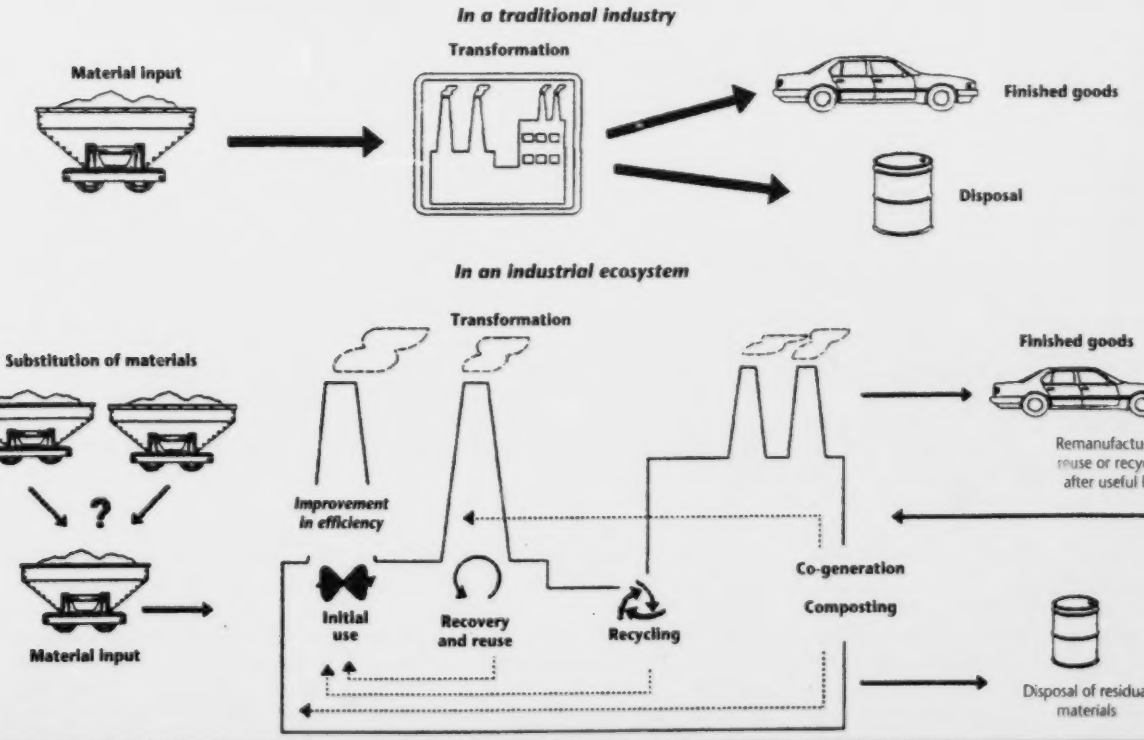

acidic precipitation, smog, ozone depletion, global warming
landfilling, incineration, contamination of surface and ground water, social disruption
Emissions
NO_x, CO, CO_2, benzene, toulene, tri-tetrechlorethelyne, styrene, acetone, CFCs, etc.
Solid waste
paper, wood, cloth, plastics, metals, rubber
The industrial park
Spilling and dumping
metals, oils, solvents, PCBs
contaminated soils (liability)
Hazardous waste
oils, solvents, chlorinated hydrocarbons, metals, sludges, solutions
Effluents
metals, solvents, paints, oils, acids, water
transportation, hazards, disposal costs, storage hazards
deterioration of water, sediment, biota quality (human health)
Legend
Type of waste
Impacts

Figure 2
Stages of processing in a traditional industry versus an industrial ecosystem

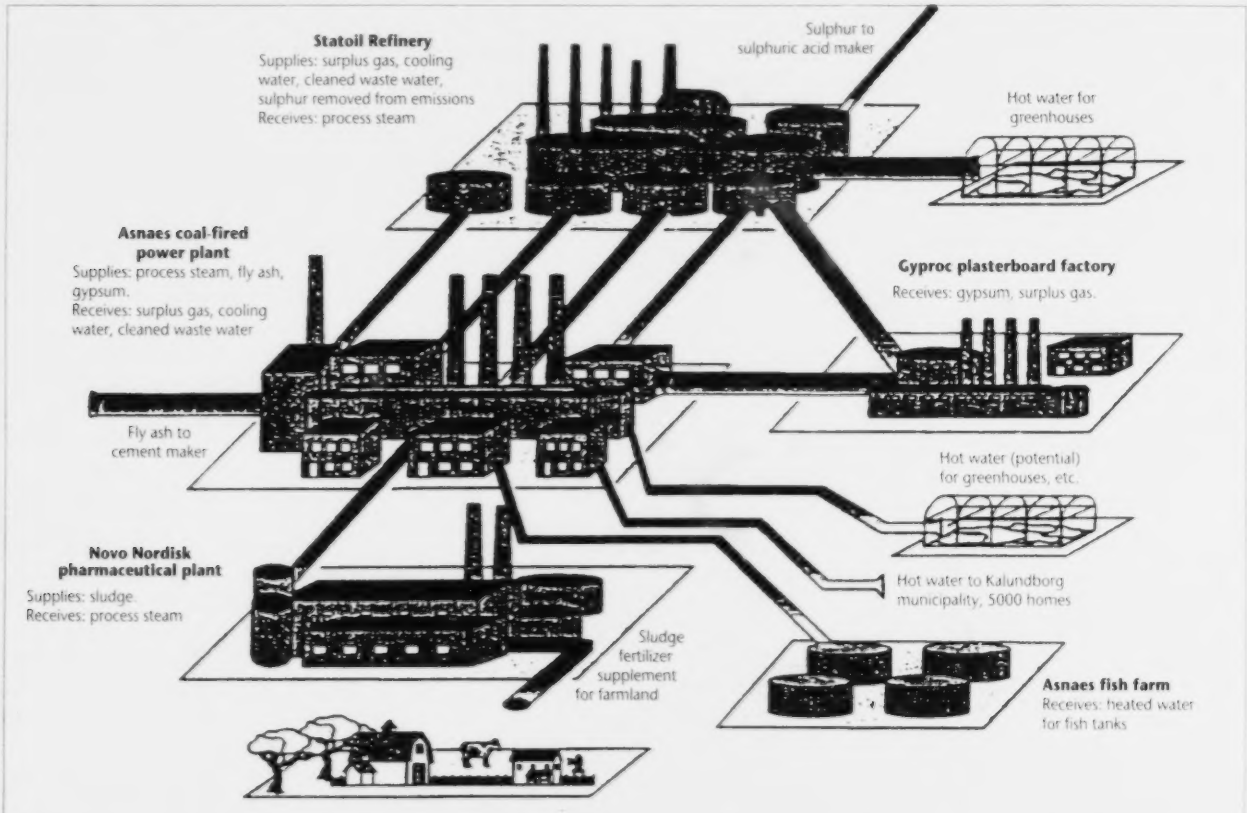


Box 2
Kalundborg – industrial symbiosis in operation

Probably the best known example of industrial symbiosis is the Kalundborg estate in Denmark. Although other examples exist, none has reached the level of integration which has evolved at Kalundborg over the last 25 years.

The heart of this industrial ecosystem is the 1,500 MW coal-fired Asnaes power station: Denmark's largest. As in the case of all fossil-fuel power stations, the maximum efficiency for conversion of the energy from combustion of coal into electrical energy is limited to around 40 per cent. The other 60 per cent is dissipated to the surrounding environment as heat, largely in the form of steam. By making this otherwise-lost energy available for other purposes, the Asnaes power station uses almost 90 per cent of the primary energy content of the coal.

While Kalundborg corresponds very closely to schemes which industrial ecologists might devise, there was no central master plan behind this symbiosis. The process has been one of **evolution,** based on individual contracts making sound economic sense.


Statoil Refinery
Supplies: surplus gas, cooling water, cleaned waste water, sulphur removed from emissions
Receives: process steam
Sulphur to sulphuric acid maker
Hot water for greenhouses
Asnaes coal-fired power plant
Supplies: process steam, fly ash, gypsum.
Receives: surplus gas, cooling water, cleaned waste water
Gyproc plasterboard factory
Receives: gypsum, surplus gas.
Fly ash to cement maker
Hot water (potential) for greenhouses, etc.
Novo Nordisk pharmaceutical plant
Supplies: sludge
Receives: process steam
Hot water to Kalundborg municipality, 5000 homes
Sludge fertilizer supplement for farmland
Asnaes fish farm
Receives: heated water for fish tanks

Heat

- 225,000 tonnes of steam is provided each year to a district heating system, equivalent to 19,000 tonnes of oil.
- The Asneas power plant makes use of its own excess heat to run a fish farm. The sludge from the fish ponds is recovered and sold as fertilizer.
- 14,000 tonnes per year of steam is supplied to the Statoil oil refinery, accounting for 40 per cent of its needs for pipe and tank heating.
- 215,000 tonnes of steam per year is supplied to the pharmaceuticals and enzyme manufacturer Novo Nordisk.

By-Products

- 80,000 tonnes per year of gypsum (calcium sulphate), recovered from the Asnaes power station's sulphur dioxide scrubber, is supplied to Gyproc, a company producing wall boards.
- The power station sells 170,000 tonnes per year of fly ash and clinker, residues from coal burning, for use in construction and road building.
- Ethane and methane from the Statoil refinery are supplied for Gyproc's drying ovens and for the power station's boilers. Gyproc consumes 900 kilograms per hour and the power station is able to avoid burning 30,000 tonnes of coal every year.
- Residue from Statoil's sulphur scrubbers is used in the production of sulphuric acid.
- Nutrient-rich sludge from Novo Nordisk is piped free to surrounding farms to be used as fertilizer. For Novo Nordisk this was the cheapest way to comply with regulations prohibiting dumping of such sludge at sea.

the conventional and industrial ecosystem views are illustrated in **Figure** 2.

The key concept here is **industrial symbiosis**. In other words companies, like natural organisms, should use each other's by-products as feedstock, rather than continually absorbing virgin materials and discarding waste. The best known example of this type of industrial symbiosis actually in operation is the Kalundborg estate in Denmark which is described in **Box 2 and referred to in several articles in this issue.**

Although industrial ecology is at present an emerging science, the concept of the eco-industrial park (EIP), as such systems as Kalundborg are also known, recently received the backing of the US President's Council on Sustainable Development, which declared, "the EIP concept serves as a model for sustainable community economic development." Several American cities are planning to set up EIPs in the near future, including Chattanooga, which has plans for four such parks. These plans are still in their infancy, but EIP may well be a concept, at least in the United States, whose time is at hand. ◆

Creating industrial ecosystems: a viable management strategy?

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Abstract

The concept of industrial ecosystems has become increasingly attractive in recent years. Properly organized and structured, they exemplify a built-in incentive to minimize wastes and losses of intermediates. However, much research (as outlined in this article) is needed in order to clarify the optimum organizational and financial structure of such an entity. Some proposals for industrial ecosystems are examined, along with some of the prerequisites for successful implementation.

Résumé

Ces dernières années, l'attrait du concept d'écosystèmes industriels n'a cessé de croître. Lorsqu'ils sont structurés et organisés avec rigueur, ils constituent l'exemple vivant d'une incitation intégrée à la minimisation des déchets et l'abandon des intermédiaires. Toutefois, comme le souligne cet article, beaucoup de recherches sont encore nécessaires afin d'identifier clairement la structure financière et organisationnelle optimale que devrait revêtir une telle entité. Certaines propositions d'écosystèmes industriels sont examinées de même qu'un certain nombre des conditions requises pour leur mise en oeuvre réussie.

Resumen

En los últimos años, el concepto de ecosistemas industriales se ha vuelto particularmente atractivo. Organizados y estructurados adecuadamente ejemplifican un incentivo incorporado para minimizar los desechos y las pérdidas de productos intermedios. Sin embargo, se necesita una amplia investigación (como se muestra en el artículo) para clarificar la estructura organizacional y financiera óptima de una entidad como ésta. Se examinan algunas proposiciones para ecosistemas industriales, conjuntamente con algunos de los prerrequisitos para su puesta en práctica exitosa.

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Introduction

Industrial ecosystems, designed "from scratch" to imitate nature by utilizing the waste products of each component firm as raw materials (or "food") for another, are an attractive theoretical idea, but as yet mostly at the proposal stage. It is important to stress that process changes to take advantage of returns to close the materials cycle are very definitely *not* another version of "end-of-pipe" treatment of wastes.

Is this an idea whose time has come? This article examines a number of such proposals and considers the prerequisites for success. It appears that there are several: First, a fairly large scale of operation is required. This means that at least one first tier exporter must be present to achieve the necessary scale. Second, at least one other major firm (or industrial sector) must be present locally to utilize the major waste of the exporter after conversion to useful form. Third, one or more specialized "satellite" firms will be required to convert the wastes of the first tier exporter into useful raw materials for the consumer and to convert the latter's wastes into marketable commodities, secondary inputs to other local firms, or final wastes for disposal. A final condition of great importance (and difficult to achieve in practice) is that a reliable mechanism be established to ensure close and long-term cooperation – i.e. information sharing – at the technical level among the participating firms. The guarantor of this cooperation must be either the first tier exporter itself, a major bank, a major marketing organization, or a public agency. The detailed mechanisms by which it can be achieved in practice remain to be worked out.

1. Returns to scale and scope

The notion of returns to scale – and the related notion of division of labour – are among the oldest and most familiar insights in economics, going back at least to Adam Smith. It is not necessary to expound them in detail again. However, it is helpful (for what follows) to remind the reader that the classic "supply-demand" intersection presupposes a rising supply curve, for the economy as a whole or for a particular good or service. This implies that the *marginal* cost of production (of the good or service) rises monotonically with output. This reflects short-term rigidities, viz. a fixed workforce, a fixed physical capital and a fixed technology.

At first sight this equilibrium picture seems incompatible with economies of scale – a point that properly bothers many thoughtful first year economics students. However, economies of scale become meaningful when we relax the assumption of a fixed set of factors of production at a static point in time. Absent the (implied) condition of short-term rigidity, it is easier to see that alternative technologies of production can, and do, exist *in principle* at different scales of operation. They are likely to differ in many ways, especially in terms of capital/labour ratio. At larger scales of operation, and especially with longer production runs, more operations can be carried out by machines or other equipment than at small scales. The physical reasons why this is true range from the obvious (longer runs = less set-up time) to the arcane (decreasing surface/volume ratios) and need not be considered further here. The important consequence is that the number of workers (or man-hours) per unit output tends to decline with increasing scale, *ceteris paribus*.

This fact, in turn, has had a major impact on economic growth in the past. Passing from a static to a dynamic framework, consider what happens when existing productive capacity in an industry is augmented by a new and more efficient plant. The new plant can produce more cheaply. Potential supply in the industry has increased. Demand will absorb the larger supply only at a lower price. If competing suppliers cut prices, demand will continue to rise. This will stimulate further investment in supply, and so on. The cycle of price cuts (permitted by economies of scale) leading to increasing demand (thanks to price elasticity of demand) has been called the "Salter cycle".

To maximize economies of scale, manufacturers in the late 19th and early 20th centuries adopted a strategy of product standardization and "mass production". These were basically American innovations. Successful exemplars range from Waltham watches, Colt 45 revolvers, Remington rifles, Yale locks, and Singer sewing machines to Ford's successful "Model T" (which was produced continuously from 1908 to 1926). At that time the keys to success in manufacturing were product standardization, division of labour, and volume (Ayres 1991). Frederick Taylor incorporated these elements, together with some others, into a formal theory of "scientific management" which strongly influenced (and was influenced by) Henry Ford.

The benefits of scale are diluted in the case of mechanical or electrical products which are evolving and improving over time. Mechanical automation requires large investments in specialized machinery and equipment, which must be depreciated. This tends to discourage technological change, since new models require new and costly production lines to be designed and custom-built (e.g. Abernathy 1978). The benefits of scale are most obvious (and easiest to analyse econometri-

cally) in the case of homogeneous commodities such as steel, petrochemicals, or electric power. Economies of scale tend to encourage industrial gigantism, and oligopolies, at the expense of competition. Economists have argued the relative benefits to consumers of scale economies vs. competition in regulated utilities, such as telecommunications, electric power, water and gas distribution, railroads, or airlines (e.g. Christensen and Greene 1976). Evidently oligopolistic pricing inhibits growth. But it appears that economies of scale were still an important engine of economic growth even for the US, and much more so for Europe and Japan, in the post-war decades (e.g. Denison 1962, 1974, 1979). Scale economies were perhaps the *only* significant growth factor for the Soviet Union and eastern Europe during that period.

Recently there have been indications that economies of scale are no longer as important as they once were. Markets for many standardized products have become saturated, at least in the West. Quantity of supply (of final goods and services) is less and less important relative to quality and variety. From the classical Tayloriste-Fordist point of view, variety (diversity) of output is incompatible with maximum efficiency. Yet there are other, hitherto neglected dimensions of production technology and other strategies for cost reduction that are more appropriate for meeting demand in markets where diversity – even "customization" – is inherently valuable.

Newer strategies maximizing "returns to scope" (or "economies of scope") have become increasingly important in recent years, thanks to the introduction of new computer-based technologies in manufacturing. In brief, the idea is that a manufacturer who can produce a large number of different products *efficiently* from a small number of flexible workers or programmable machines will be more able to meet variable den. nd than a manufacturer with inflexible machines geared to a single standardized product. It appears that advanced forms of computer-controlled production, linked with computer-assisted design and engineering – known as computer-integrated manufacturing, or CIM – offer a feasible path away from traditional mass production (e.g. Goldhar and Jelinek 1983, 1985; also Ayres 1991a).

Another hitherto neglected dimension of strategy (with a few exceptions) is to maximize *systems integration*. We now consider this strategy in more detail.

Figure 1
Optimal abatement in economic equilibrium

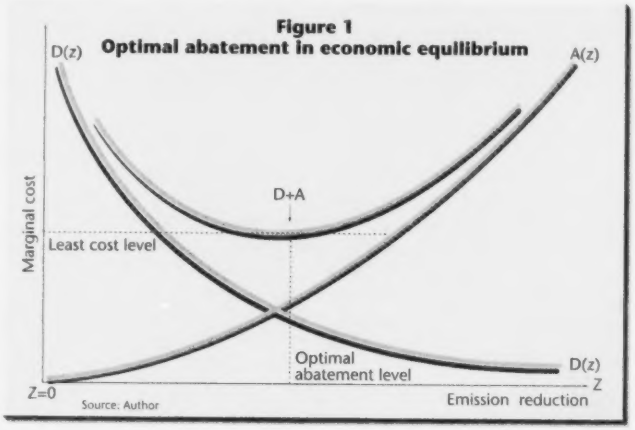
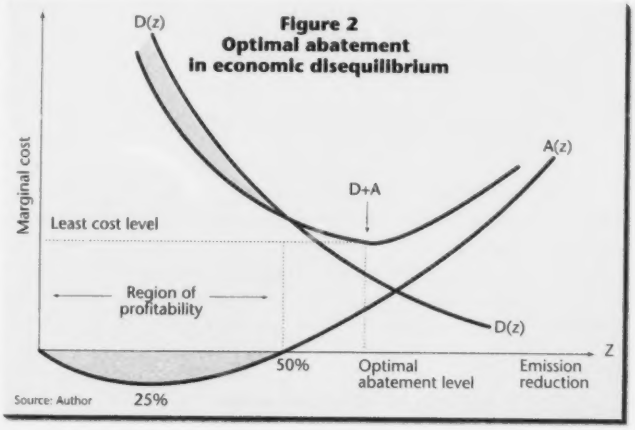


Figure 2
Optimal abatement in economic disequilibrium



2. Returns to systems integration

Having emphasized that viable production strategies today no longer depend exclusively on standardization and economies of scale, one can look more systematically for other sources of competitive advantage. In particular, we wish to consider "returns to integration", which are (equivalently) "returns to internalization" (or "closure") of the materials cycle.

The classical illustration of this strategy was the Chicago meat packers who prided themselves on recovering and finding markets for "everything but the squeal" of the slaughtered animals. The link between scale and integration is obvious: only a large-scale operator could invest in the various specialized facilities needed to produce various meat products from steak to sausage, lard (some of which was saponified to produce soap), pet food, bone meal, blood meal, gelatin (from hooves) and even hormones from animal parts. Pig bristles became shaving brushes and hairbrushes, while the hides were tanned to make leather.

Coke, used in blast furnaces, offers another historical example. The earliest "beehive" coke ovens were terrible polluters. However, the "by-product" coking process, first introduced by Koppers in Germany, changed this situation significantly by capturing both the combustible gas and other by-products of the coking operation. High quality coke-oven gas became available near the Ruhr steelworks in the late 19th century. Its availability encouraged a local inventor, Nicolaus Otto, to commercialize a new type of compact "internal combustion" engine – to replace the bulky steam engine (and its associated furnace, boiler and condenser) – to supply power for small factories. By-product coke ovens also produced coal tar. Coal tar was the primary source of a number of important chemicals, including benzene, toluene and xylene, as well as aniline. Aniline was the raw material for most synthetic organic dyestuffs, the first important product of the German chemical industry. Coke ovens were also the source of most industrial ammonia, which was the raw material for both fertilizers (usually ammonium sulphate) and nitric acid for manufacturing explosives such as nitroglycerine.

The modern petrochemical industry is the best current example of systems integration: it begins with a relatively heterogeneous raw material (petroleum), which consists of a mixture of literally thousands of different hydrocarbons. The first petroleum refiners of the 19th century produced only kerosine ("illuminating oil") for lighting and tar for road surfaces and roofing materials. The lightest fractions were lost or flared; even natural gasoline had few uses (except as a solvent for paint) until the liquid-fueled internal combustion engine appeared on the scene in the 1890s. By the second decade of the 20th century the market for petroleum products had become mainly a market for automotive fuels; after 1920 this market expanded so rapidly as to create a need for "cracking" heavier fractions and, later, recombining lighter fractions (by alkylation) to produce more and more gasoline. Heavier oils found uses in diesel engines as lubricants, as fuel for heating homes and buildings, and as fuel for industrial boilers and electric power plants. Meanwhile, a great deal of natural gas was found in association with petroleum deposits and a beginning was made on the long process of capturing, processing and utilizing this new resource.

By the 1930s, by-products of petroleum and natural gas process engineering began to find other chemical uses. In particular, ammonia and methanol were derived from methane, from natural gas. Then ethylene (produced, at first, by pyrolysis of ethane separated from natural gas) became cheap, as did hydrogen. This encouraged the development of a family of synthetic polymers, starting with polyethylene and followed by polyvinyl chloride. Natural gas liquids and light fractions of petroleum refining also became the basis of most synthetic rubber production (via butadiene). Propylene, from propane, is now second only to ethylene as a chemical feedstock. Another whole family of chemicals was created from benzene, also a by-product of petroleum refining. Phenol, the basis of polystyrene and phenolic resins, is a benzene derivative. Finally, the refining process has become a major source of sulphur

Most of the organic chemicals and synthetic materials produced today are derived from one of

these few basic feedstocks. A very sophisticated technology for converting a few simple hydrocarbon molecular structures into others of greater utility has arisen. Light fractions become chemical feedstocks. The heavier fractions, including asphalt, are the least valuable (per unit mass), but some products of the heavy fractions – like lubricants and petroleum coke – are extremely valuable indeed. It is fair to say that today there are scarcely any wastes from a petroleum refinery. There is a continuing trend towards adding value to every fraction of the raw material. While most petroleum products are still used for fuel, the fuel share is actually declining and the share of fuel for stationary power plants and space heating is declining quite fast. It is virtually certain that these "low value" uses of petroleum will be displaced in a few decades by higher value uses without any intervention by governments.

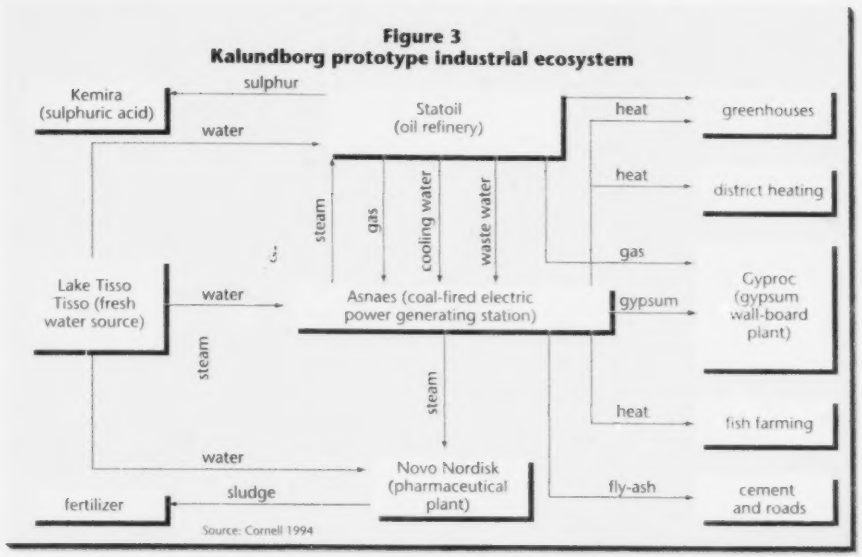
To be sure there are other chemical families in which by-products have been much harder to utilize. One example is biomass. Cellulose and cellulosic chemicals (e.g. rayon) are derived from wood, but about half of the total mass of the harvested roundwood – lignins – is still wasted or burned to make process steam. There are a few chemical uses for lignins, but no more than a small percentage of the available resource is consumed productively except as low grade fuel for use within the pulp/paper plants.

The idea of converting wastes into useful products via systems integration has recently become a popular theme among environmentalists. The 3M Company introduced a formal programme, beginning in 1975, with the catchy title "Pollution Prevention Pays" or PPP. Dow Chemical Co. has its own version, namely "waste reduction always pays" or WRAP. Others have followed suit. These acronyms are not merely "awareness raisers" to attract the attention of managers and staff; they also contain an element of generalizable truth. Unquestionably, it is socially and environmentally desirable to convert waste products into salable by-products, even though the economics may be unfavourable at a given moment of time. However, the economic feasibility of converting wastes into useful products often depends on two factors: (1) the scale of the waste-to-by-product conversion process and (2) the scale of demand (i.e. the size of the *local* market).

For example, low grade sulphuric acid is not worth transporting but it can be valuable if there is a local use for it. Thus, sulphuric acid recovered from copper smelting operations is now routinely used to leach acid-soluble oxide or chalcocite copper ores; the leachate is then collected and processed by solvent extraction (SX) technology and electrolytically reduced by the so-called electro-winning (EW) process. The combined SX-EW process was barely commercialized by 1971, but already accounts for 27 per cent of US copper mine output and about 12 per cent of world output. Capacity is expected to double by the year 2000.

Similarly, sulphur dioxide, carbon monoxide and carbon dioxide are both needed for certain chemical synthesis processes, but these chemicals cannot be economically transported more than a few kilometres at most. Hydrogen, produced in petroleum refineries, can be compressed and shipped, but it is much better to use it locally. A hydrogen pipeline network has been built for this purpose in the Ruhr Valley of Germany. So-called blast furnace gas can be burned as fuel, but it is not economical to transport very far. There are numerous examples in the chemicals industry, especially. Closing the materials cycle can take the form of creating internal markets (i.e. uses) for low value by-products by upgrading them to standard marketable commodities. (This often depends, incidentally, upon returns to scale, but only in a particular context.)

Figure 3
Kalundborg prototype industrial ecosystem



To summarize, there are significant potential returns to internalization of the materials cycle. For instance, the so-called integrated steel mill (including its own ore sintering and smelting stages) is an example. It would not pay to produce pig iron in one location and ship it to another location for conversion to steel, for two reasons: 1) there would be no way to use the heating value of the blast furnace gas, and 2) the molten pig iron would cool off *en route* and it would have to be remelted again. Thus energy conservation considerations, in this case, dictate integration. The same logic holds for petroleum refineries and petrochemical complexes. In each case there are a number of low value intermediate products that can be utilized beneficially if, and only if, the use is local. However, these examples of integration obviously require fairly large scale for viability. This is in direct contrast to the strategy of "end-of-pipe" waste treatment and disposal, which is normally practised in smaller operations.

3. Integrated industrial ecosystems

The idea of "industrial ecology" has taken root in the past few years, especially since the well-known article by Frosch and Gallopoulos in a special issue of *Scientific American* (Frosch and Gallopoulos 1989). The analogy with ecosystems is obvious and appealing. In a "perfect" ecosystem the only input is energy from the sun. All other materials are recycled biologically, in the sense that each species' waste products are the "food" of another species. The carbon-oxygen cycle exemplifies this idea: plants consume carbon dioxide and produce oxygen as a waste. Animals, in turn, require oxygen for respiration, but produce carbon dioxide as a metabolic waste. An ecosystem involves a "food chain" with a number of interacting niches, including primary photosynthesizers (plants), herbivores, carnivores preying on the herbivores, saprophytes, parasites and decay organisms.

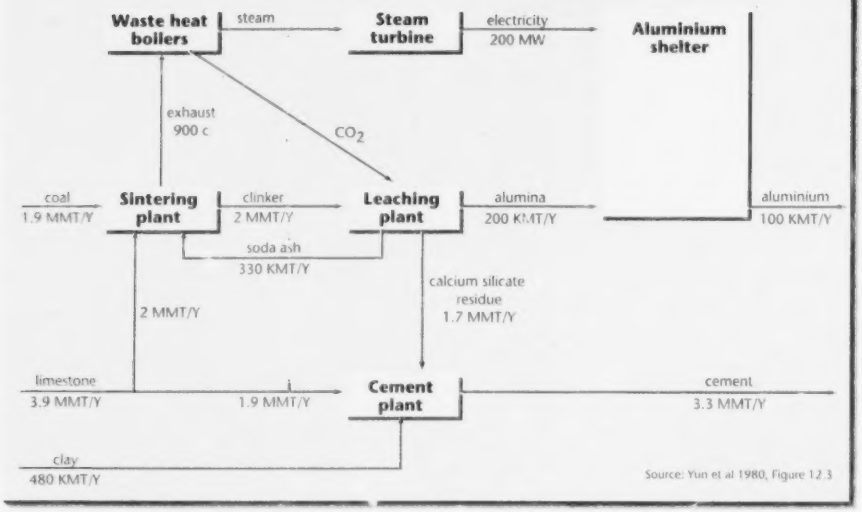
The notion of deliberately creating "industrial ecosystems" has become increasingly attractive in recent years. As the author Paul Hawken has commented, "Imagine what a team of designers could come up with if they were to start from scratch, locating and specifying industries and factories that had potentially synergistic and symbiotic relationships" (Hawken 1993, p. 63).

An industrial ecosystem, then, could be a group of firms grouped around a primary raw material processor, a refiner or convertor, and a fabricator, various suppliers, waste processors, secondary materials processors, and so forth. Or it could be a group of firms grouped around a fuel processor or even a waste recycler. The main requirement is that there be a major "export product" for the system as a whole, and that most of the wastes and by-products be utilized locally.

In principle, this logic can be generalized. In conventional economic terms, technological progress can change the conventional "equilibrium" picture shown in **Figure 1** to a situation more like that in **Figure 2**, where there is some room for improvement at zero or even negative cost. Technological change can create new unrecognized (hence unexploited) economic opportunities. Thus, there may be some cases where there are potential returns to systems integration that have not been applied in practice up to now. Future changes, e.g. in resource prices, may create even more such opportunities.

At first glance systems integration looks rather like old style "vertical integration", except that there is no need for all of these enterprises to have common ownership. In fact, the flexibility and

Figure 4
Conceptual diagram of an aluminium KOMBINAT



Source: Yun et al 1980, Figure 12.3

innovativeness needed for long-term success is more likely to be promoted by dispersed ownership. Yet a considerable degree of inter-firm cooperation is needed as well. We will return to this point later.

4. The Kalundborg example

Whether by accident or through intention, an interesting example of such a system has evolved in Denmark and has received considerable attention (e.g. Frosch and Gallopoulos 1989). The Kalundborg prototype industrial ecosystem began in the 1960s when the Asnaes electric power plant modified its operations so as to produce process heat in the form of steam that could be sent to the nearby Statoil refinery. (This is an old idea, known as "co-production" of steam and electricity; it permits the power plant to achieve a higher overall thermal efficiency by producing a little less electricity and generating some steam instead, at a temperature high enough to be of some use to other users.) Once the idea of co-generation was taken seriously, it was found that the power plant could also sell steam to a pharmaceutical plant, greenhouses, local homes, and its own fish farm (see **Figure 3**).

The Kalundborg complex goes far beyond co-production, however. The Statoil refinery had excess high-sulphur gas. By introducing a hydrodesulphurization stage (admittedly a rather standard procedure nowadays), it recovered sulphur for sale to a sulphuric acid producer, Kemira, and sold the cleaner gas to Asnaes, saving coal and to a local gypsum wallboard manufacturer, Gyproc. Meanwhile Asnaes also introduced a lime scrubber to remove the sulphur from its flue gases. The calcium sulphate sludge from this process is also sold directly to the wallboard manufacturer, replacing gypsum that would otherwise be needed. Ash from Asnaes is used for roadbuilding and cement manufacturing.

Finally, fish processing waste from the fish farm and (sterilized) waste sludge from the fermentation process in the Novo Nordisk pharmaceutical plant are sold to local farmers as fertilizer. Novo Nordisk is the world's largest producer of insulin and industrial enzymes, with factories in seven countries. However, the Kalundborg facility is one of its largest. The firm has published a very detailed environmental report (Novo Nordisk 1993) which outlines the production cycle for the firm as a whole. It used 214,000 tonnes of raw material inputs in that year, along with 4 million cubic metres of water. It discharged 2.1 million cubic metres of non-hazardous treated wastewater, 26,500 tonnes of non-hazardous wastes and 1100 tonnes of hazardous wastes (oils and chemicals). But 1.6 million cubic metres of organic liquid wastes was recycled as agricultural fertilizer.

Obviously most of the components of an industrial ecosystem are present in Kalundborg, from the primary producers to the equivalent of the decay organisms. However, the combination of industrial activities in that location is sufficiently unusual that it is not clear how far the Kalundborg example can be generalized.

5. Other possible industrial ecosystems

Several proposals superficially comparable to the Kalundborg example have been made. One of the oldest is the "nu-plex" concept, promoted vigorously by nuclear power advocates at Oak Ridge National Laboratory (US) in the 1970s. It was, however, basically an idea for an industrial park for large-scale electric power consumers.

A more interesting scheme, from our perspective, is a proposed *aluminum kombinat* for utilizing low grade (high ash-content) anthracite coal to recover aluminium and cement (Yun et al. 1980). The project was conceived at the Korean Institute of Science and Technology (KIST) as a possible answer to two problems. First, the city of Seoul needed to dispose of several million tonnes of coal ash each year. At the same time, South Korea was totally dependent on imported aluminium and there was a strong desire to become self-sufficient. After several years of investigation, the *kombinat* scheme evolved. As of 1980, a 60 tonne per day pilot plant was in operation and process economics appeared to be favourable.

In brief, the energy from coal combustion would be used to generate the electric power for aluminium smelting. The inputs to the *kombinat* would be low-sulphur anthracite coal (1.9 MMT/y), limestone (3.9 MMT/y) and clay (0.48 MMT/y). Outputs would be 100 kMT of aluminium and 3.5 MMT of Portland cement. The heart of the scheme is an alumina plant consisting of two units: a sintering plant (coal + limestone + soda ash) yielding high temperature exhaust gases (900°C) for the steam turbine and 2 MMT/y clinker for the leaching unit. The latter grinds the clinker and leaches the alumina with hot sodium carbonate solution. The soda combines with alumina, yielding sodium aluminate in solution, while the lime combines with silica precipitating as dicalcium silicate. The latter is sent to the cement plant. The sodium aluminate is then treated in a conventional sequence, first by adding lime to precipitate dissolved silica and then by carbonation of the solution (with CO_2 from the waste heat boiler) to reconstitute the soda ash and precipitate aluminium hydroxide. When aluminium hydroxide is dehydrated (i.e. calcined) it becomes alumina. About 40 kMT/y of soda ash would be lost in the soda cycle, and would have to be made up. According to calculations and test results, aluminium recovery from the ash would be about 71 per cent, while the thermal efficiency of the electric power generating unit would only be about 15 per cent due to the considerable need for process steam by the leaching plant, mostly for calcination. The basic scheme is outlined in **Figure 4**.

A scheme similar to the *kombinat* was analysed independently in the late 1970s by TRW Inc. for the US Environmental Protection Agency (Motley and Cosgrove 1978). The idea was motivated by the fact that flue gas desulphurization (FGD) technology was just being introduced by coal-burning electric power plants. The technology then being adopted was lime/limestone scrubbing, which captures sulphur dioxide quite effectively but generates large quantities of calcium sulphite/sulphate wastes. The TRW study evaluated a possible use for these wastes.

The scheme was based on a conceptual coal-burning power plant generating 1000 MW, which generates 1 MMT/y of lime/limestone scrubber wastes. The core of the scheme would be a sinter plant in which the sulphate sludges react with carbon monoxide produced by burning coal (273 kMT), clay (300 kMT/y) and soda ash (12 kMT/y) to yield soluble sodium aluminate, dicalcium silicate and hydrogen sulphide. These, in turn, are processed by standard means (described briefly in the description of the *kombinat* above) to yield calcined alumina (70 kMT), elemental sulphur (156 kMT) and dicalcium silicate (625 kMT). The latter, in turn, is the major ingredient to produce 850 kMT of Portland cement. At typical market prices, this scheme appeared to be viable or nearly so. It would certainly be viable given a realistic credit for FGD waste disposal.

Another interesting proposal for an industrial

ecosystem comes from Poland (Zebrowski and Rejewski 1987). It is actually a set of interrelated proposals utilizing two basic technologies that have been under development in Poland. The first is coal pyrolysis in the gas stream (PYGAS), a patented technology that has already been adopted at several Polish industrial sites. It is particularly suited to upgrading existing power plants at minimal capital cost. The basic idea is to feed powdered coal into a hot gas stream (about 800°C) where it pyrolyzes very rapidly (on the order of one second). Pyritic sulphur also decomposes at this temperature. The gas stream passes through a cyclone, where desulphurized carbon char dust is collected and removed. It is usable as a direct substitute for powdered coal in the boilers. Some of the gas is recycled. The pyrolysis gas can be desulphurized and burned or used as feedstock for chemical processing. The second building block is a technology derived from PYGAS for pyrolysis of recycled gas streams, PYREG, specialized to the case of lignite. It has been developed to the large-scale laboratory test stage at the Industrial Chemistry Research Institute (ICRI) in Warsaw.

The idea is not qualitatively different from numerous other proposals for coal gasification, but the authors have given careful consideration to the use of these technologies to integrate existing disconnected systems, especially with respect to sulphur recovery and fertilizer production. This concept is called the Energo-Chemical PYREG site, or simply ENECHEM. The base case for comparison would be a surface lignite mine (18 MMT/y) with 0.5 per cent sulphur content. This would feed a power station generating 2160 MW of electricity. Lignite in Poland (and central Europe generally) contains 2-10 per cent xylites (5 per cent average) – organic compounds related to xylene ($C_6H_4(CH_3)_2$) which are not recovered when lignite is simply burned.

In the base case, annual wastage of xylites would be 900 kMT. By contrast, PYREG technology permits the direct recovery of xylites in the form of high grade solid fuel (semicoke, 200 kMT/y), fatty acids and ketenes (65 kMT/y) and gaseous aromatics (benzene, toluene, xylene or BTX), which are normally derived from petroleum refineries. The proposed ENECHEM site would include a power station, but instead of burning lignite directly to generate 2160 MW, as in the base case, it would gasify the lignite via PYREG as shown in **Figure 5**, yielding semicoke powder plus volatile hydrocarbons, tar and phenolic water. The semicoke powder would then be burned in the power station (generating 1440 MW, and emitting about 97 kMT/y SO_2).

The volatile hydrocarbon fraction of the PYREG output would be desulphurized – by conventional Claus technology – yielding about 67 kMT/y of elemental sulphur S. The condensibles would be separated as liquid propane gas (LPG) for domestic use (150 kMT/y). The non-condensibles, consisting of methane and ethane or synthetic natural gas (SNG), would be available as a feedstock to any natural gas user, such as an ammonia synthesis plant (318 kMT/y). The tar from the PYREG unit could be refined much as petroleum is, yielding liquid fuels and some light fractions (C_2-C_4) that would go to the gas processing unit. The yield of gasoline and diesel oil would be 430 kMT/y and 58 kMT/y, respectively, plus 75 kMT/y of heavy fuel oil. (Obviously the tars could be a supplementary feed to a co-located conventional petroleum refinery, but the incremental outputs would be much the same.) The phenolic water would be processed to recover phenols (13 kMT/y), cresols (27 kMT/y) and xylenoles (26 kMT/y).

Obviously the details of ENECHEM could be varied considerably, but the scheme as outlined in the previous paragraph (**Figure 6**) would reduce sulphur dioxide emissions by roughly half (from 180 kMT to 97 kMT). It would produce less electric power, but in exchange for a reduction of 720 MW it would yield 318 kMT (400 million cubic metres) of SNG, 150 kMT LPG, 430 kMT gasoline, 480 kMT diesel fuel, 75 kMT heavy fuel oil (less than 1 per cent S), 66 kMT of phenols, cresols and xylenoles, and 67 kMT of sulphur (99.5 per cent).

A recent proposal by Cornell University to the US Environmental Protection Agency differs sharply from the schemes outlined above. Instead of focusing on utilizing an existing natural resource more efficiently, it would attempt to assemble the elements of an industrial ecosystem around a municipal waste treatment facility. In other words, it is essentially a scheme to "mine" wastes *per se*. The proposal points out that in the 1970s a number of facilities were built with the idea of reducing landfill volumes by recovering the combustible fraction, along with ferrous metals, and converting it to a refuse-derived fuel (RDF), to be sold to a local utility to help defray the costs of operating the facility. Many of these facilities operated only briefly or not at all.

The Cornell proposal would extend the earlier waste treatment concept in two ways. First, it would include not only municipal wastes but also a variety of other industrial wastes. Second, it would employ advanced technologies to produce a number of salable by-products, one of which would be fuel gas. (Nevertheless, its success would still depend on one or more utilities that would undertake to accept the gaseous fuel generated.)

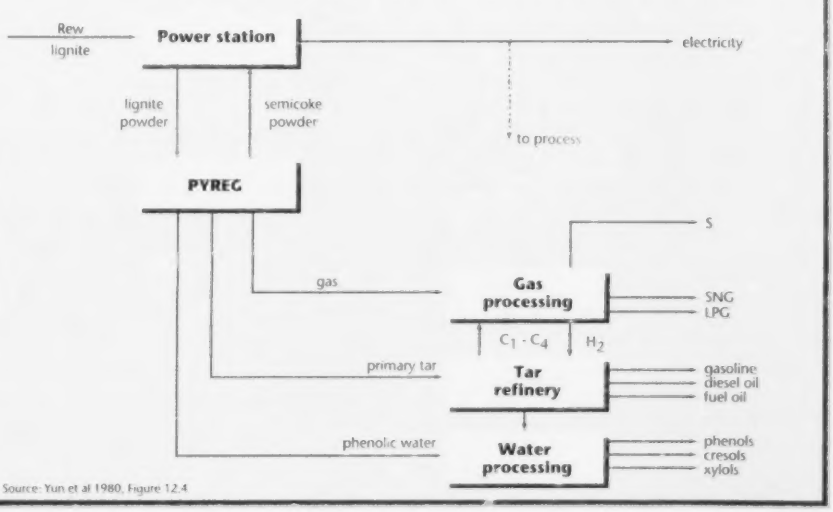
Also, in contrast with other schemes outlined in this chapter, it would involve no detailed prior planning of the site or the technology to be used beyond the creation of an organizational structure to seek out potential participants. This approach is almost mandatory, at least in the US, where central planning is virtually anathema today. Nevertheless, the proposal (if supported) would offer some useful insights into how a cooperative entity might be created from essentially competitive, independent production units. Or, indeed, whether this is possible.

A final example might be "Coalplex", first proposed by the author some years ago (Ayres 1982) and revised more recently (Ayres 1993 a,b). It too would be coal-based. Like the Polish scheme it would start by gasification of the coal, recovering sulphur for sale and using the coal ash as a source of alumina (and/or aluminium), and ferrosilicon (**Figure 7**). The most attractive version – albeit somewhat theoretical – would utilize the direct (hydrochloric) acid leaching process for aluminium chloride recovery and the ALCOA process for electrolysis of the chloride. The gasified coal would be (partly) burned on site to produce electric power for the aluminum smelter and electric furnaces. A variant would also produce carbon anodes for the aluminum smelter from coke made from gasified coal (instead of petroleum coke). There are, in fact, a number of possible variants, none of which has been adequately analysed to date.

6. Concluding comments

The key feature of most industrial ecosystems that have been proposed is what might be termed "economies of integration". To be sure, large scale is also required in most cases. But beyond that, both vertical and horizontal integration are required. All industrial ecosystems essentially depend on

Figure 5
Lignite-burning power plant modified via PYREG

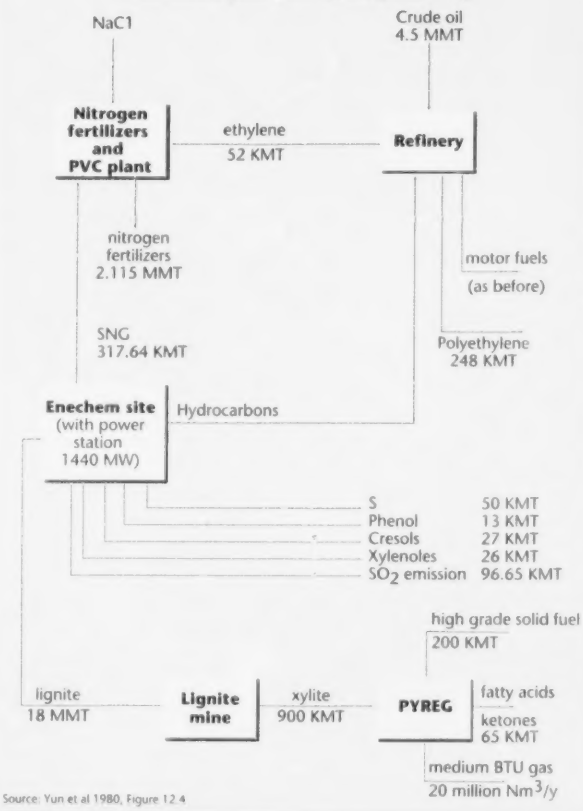


Source: Yun et al 1980, Figure 12.4

converting (former) waste streams into useful products. This means that some producers must be induced to accept unfamiliar inputs (i.e. converted wastes) rather than traditional raw materials. In some cases they will have to invest large sums of money to create new processing facilities, based on unproven – or semi-proven – concepts.

An industrial ecosystem must look like a single economic entity (firm) from the outside. It will have consolidated inputs and outputs (products). It will compete with other such entities (firms) in both raw material and product markets. It will also compete with other firms for capital. From the inside, however, central ownership with hierarchical management is almost certainly not the optimum solution. Too much depends on very sensitive and continuous adjustments between the different components of the system. This is much more compatible with markets – provided all parties have relatively complete information – than it is with centralized top-down management (as critics of Taylorism have been saying for a long time). Yet the modern version of a conglomerate, consisting of autonomous units linked to a corporate parent by a purely financial set of controls with each component competing for funds on the basis of profits, cannot work either.

Figure 6
Systems integrated with ENECHEM and additional plant for xylite procesing



Source: Yun et al 1980, Figure 12.4

Evidently, an industrial ecosystem based on a major primary "exporter" with a galaxy of associated waste convertors is quite unlike a traditional impersonal "market", where goods of known and constant quality are bought and sold through intermediaries. In a traditional market there are many competing suppliers and many competing consumers. Because only high value goods are physically shipped over distances, many suppliers need not be local. Thus, traditional industrial systems can be quite decentralized.[4]

In an industrial ecosystem, for obvious reasons, low-value materials from a first tier exporter must be utilized locally. Assuming there is one major waste that can be converted into a useful raw material, there must also be a local user for that raw material. This is likely to be a fairly large firm also, to achieve the necessary scale of operation. Other satellite firms in the complex will have only one supplier for a given input and one consumer for a given output.

The necessity for close long-term cooperation and planning between waste producers and consumers is obvious. Neither can change either processes or production levels without strongly affecting the other. Less obvious, but not less important, is the corresponding need for relatively complete disclosure of all relevant technological information on both sides. Being accustomed to a culture of secrecy, this condition will be very difficult for most firms to achieve. In general, it appears that an enforcement mechanism will be needed to ensure cooperation.

There are three existing models for a cooperative system. One is the "common ownership" model of vertical integration, in which a single corporate entity owns all, or most, of its suppliers and manages the whole collection centrally. AT&T, GE, GM, IBM, Standard Oil (New Jersey) and US Steel were created by multiple mergers to dominate an industry and mostly followed this pattern. But, as the example of GM illustrates, vertical integration is no longer necessarily an advantage. In fact, GM's principal corporate disadvantage, *vis à vis* its competitors, is that it obtains more of its components from wholly owned subsidiaries that are forced to pay high wages negotiated with the United Auto Workers Union than do other auto firms. The Japanese companies are the least vertically integrated of all. But perhaps the major problem with vertical integration is that it is too cumbersome. IBM has lost ground to a number of smaller, nimbler competitors mainly because decision-making is too centralized and slow.

The second model for inter-firm cooperation is most familiar in Japan, where it is known as the *keiretsu*. The *keiretsu* is a family of firms, normally controlled indirectly by a large bank, with links to a common trading company and several major first-tier manufacturers spread over a range of industries. There is also, typically, a collection of smaller satellite suppliers for each first tier company. Most of the larger firms in the group have interlocking stockholdings, and the smaller firms tend to be controlled by the larger ones, which are their customers. Thus long-term relationships are essentially guaranteed by financial means.

The diversified-portfolio conglomerate, as exemplified in the US (e.g. ITT, LTV, Textron, Berkshire-Hathaway, Seagrams) offers a superficially different scheme. In principle, it could also be a mechanism for obtaining inter-firm cooperation by means of financial controls. The diversified portfolio version rarely attempts any such thing, however. On the contrary, these entities are normally created by financiers in order to exploit "synergies" (which often turn out to be illusory) and little or no actual cooperation at the technical level takes place. The AT&T purchase of NCR, which had a technological justification, might turn out better. But none of these examples seems ideal to fit the needs of an industrial ecosystem.

The third model for inter-firm cooperation is also top-down, usually being organized by marketing organizations. Families of (largely unrelated) suppliers with long-term contracts have been created by a number of large retail marketing firms, such as Sears-Roebuck, WalMart, K-Mart and MacDonalds. Normally, however, each supplier manufactures a different product, so there is actually little need for technical cooperation among them. But, in at least one case, the supplier family evolved from a large-scale manufacturer. The traditional Italian textile industry, originally a group of large multi-product companies in a declining industry, has radically reconstructed itself by a policy of deliberate functional spin-offs leaving many small subcontractors to a dominant marketer (Benetton). This self-induced change has been extraordinarily successful. However, it is not particularly relevant to the problem of creating industrial ecosystems.

An industrial ecosystem could theoretically be created by an actual merger of many existing firms at a single location, to promote the necessary inter-firm cooperation. But this is unlikely to make sense except in very rare instances. More likely, the necessary cooperation could be induced by a local government or some other public body, as seems to have been the case in Kalundborg. On the other hand, no public entity in any of the major industrial countries (to our knowledge) has yet moved beyond the concept stage.

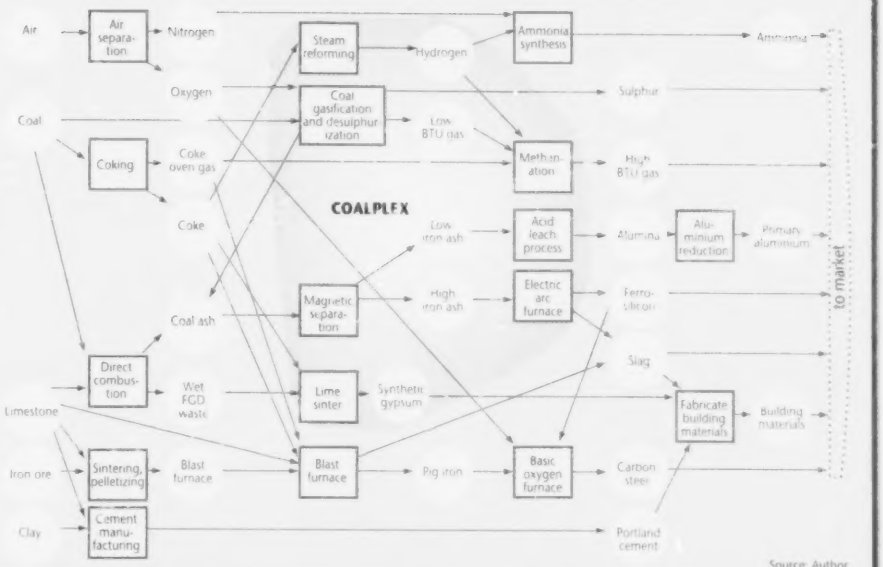
One of the most ambitious such concepts is the "Eco-Park" proposed by a group at Dalhousie University, Nova Scotia (Cote et al. 1994). The basic idea is to convert an existing, traditional "industrial park" – the Burnside Industrial Park in Dartmouth, Nova Scotia – into an industrial ecosystem. The Burnside Industrial Park already has a base of 1200 businesses, but the land was assem-

bled and provided by the city with infrastructural funds provided by the central government of Canada through the Atlantic Development Board, a regional development agency. The city still retains approximately 3000 acres. Thus public agencies retain very significant influence over the future evolution of the area. However, it is unclear just how this potential influence can be brought to bear to create the necessary incentives *and mechanisms* to create a successful Eco-Park.

Each component of an industrial ecosystem has its unique role to play. Financial allocations among components cannot be made on the basis of "profits", for the simple but compelling reason that some components will do business only with others, and there is no unique or objective way to set meaningful prices for all internal transactions. (Companies do it in a variety of ways – often to minimize taxes – but all have their disadvantages and critics.) Only by comparing different internal technology choices and transactional arrangements in terms of their impact on the external competitiveness of the system *as a whole* can objective choices be made. Moreover, such comparisons are necessarily dynamic rather than static, which makes the decision process very complex indeed.

To summarize, industrial ecosystems are very appealing in concept. Properly organized and structured, they exemplify a built-in incentive to minimize wastes and losses of intermediates. But much research is needed to clarify the optimum organizational and financial structure of such an entity.

Figure 7
Hypothetical process-product flows for Coalplex



Notes

1. See, for example, Siegfried Giedion's *Mechanization Takes Command*, Part IV (Giedion 1948, pp. 213-240).

2. Even the most modern coke ovens are not regarded as desirable neighbours, since there are still non-negligible emissions from leaks, dust and especially from the quench water.

3. The Otto cycle gas engines were quickly adapted to liquid fuels, higher speeds and smaller sizes by one of Otto's associates, Gottlieb Daimler. The Daimler engine, in turn, made possible the motor vehicle and the airplane.

4. See, for instance, the chapter on copper in US Bureau of Mines *Minerals Yearbook, 1989* (USBM 1989).

5. In reality, the biosphere does *not* recycle all of the important nutrient elements – notably phosphorous and calcium – without help from geological processes; but this is probably a quibble.

6. Patent No. 87904. License available from PROSYNCHEM Design Office, Gliwice, Poland.

7. Sulphur recovery in PYREG technology is only 40-60 per cent, but since Polish lignite has a very low sulphur content (0.5 per cent) this is not considered to be a major disadvantage.

8. Indeed, the pattern established by many multinational manufacturing firms is to build various elements of a product "line" in several different countries, thus both achieving the benefits of scale, on the one hand, and minimizing the risk of being "held up" by local governments or unions. Ford's "world car" concept is a good example, although IBM was (is) perhaps the most successful practitioner of the policy of decentralized international supply.

9. ALCOA, Ethyl Corp and Xerox achieved monopoly status originally through tight control of patent rights, but both Ethyl and Xerox lost dominance when the patents expired. In ALCOA's case, as with AT&T and Standard Oil, the monopoly was broken by anti-trust action by the US government.

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Designing eco-industrial parks: the US experience

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Abstract

Eco-industrial parks (EIPs) provide a unique opportunity to create new technologies to fit the needs of particular locations. In the United States in 1994, the President's Council on Sustainable Development designated four communities as demonstation sites for EIP's. The PCSD was interested in exploring "the practical application of ecological principles to industrial activities and community design". These demonstration sites, with their different visions of EIP development, are described in the following article.

Résumé

Les parcs éco-industriels offrent une opportunité unique pour créer des nouvelles technologies adaptées aux besoins d'une situation géographique donnée. Aux Etats-Unis en 1994, Le Conseil présidentiel pour le Développement durable a désigné quatre communautés comme sites de démonstration de ce type de parc. Le Conseil souhaite explorer « l'application pratique de principes écologiques aux activités industrielles et à la conception communautaire ». Ces sites de démonstration et leurs différentes approches en matière de développement de parcs éco-industriels sont décrits dans l'article qui suit.

Resumen

Los parques ecoindustriales (EIP) ofrecen una oportunidad sin igual de crear nuevas tecnologías para ajustarse a las necesidades de sitios particulares. En Estados Unidos en 1994, el Consejo del Presidente sobre Desarrollo Sostenible. El "PCSD" designó cuatro comités como sitios de demostración para EIP. EL PCSD se interesó en explorar " la aplicación práctica de principios ecológicos para actividades industriales y diseño comunitario ". Estos sitios de demostración, con sus diferentes visiones de desarrollo EIP, se describen en el articulo siguiente.

Introduction

The next century will give rise to a new kind of industrial development that uses resources dramatically more effectively and redefines the manufacturing economy. Current trends in sustainable development and business management are converging on a new model of industrial operation, exemplified by the discussion of eco-industrial parks (EIPs) in the United States and Canada.

At its core, an EIP is very simple. It strives simultaneously to increase business success while reducing pollution and waste. Rooted in the emerging discipline of industrial ecology, an EIP mirrors natural systems. As single organisms can be viewed alone or in a larger ecology, single enterprises can organize themselves in more complex business ecologies. When we refer to EIPs it is far more than a shared plot of land. By moving to higher levels of interdependent organization quantum level improvements can be realized in resiliency, flexibility and resource conservation. This pays off for the business and the environment.

In North America, there is growing excitement about the possibilities reflected in EIPs. In the United States, the President's Council on Sustainable Development (PCSD) formed an active task force on EIPs as one element of building a sustainable economy. The Environmental Protection Agency (EPA) and the Department of Energy (DOE) have been exploring the possibilities for EIPs to follow on these recommendations. Communities across North America have begun to examine ways to create these new entities especially as an eco-responsible way to reclaim brownfields. Yet, at this writing, EIPs for the most part remain an intriguing prospect on the drawing board. No community in the United States has an operating interconnection of businesses that can be called a functioning EIP. In this article we describe the thinking that characterizes these developments. Before long EIPs will stand the test of market and regulatory realities.

Why is the concept so appealing? Inherently the challenge of reconciling the demands for business and environmental excellence is a strong attraction. There are many elements of EIP activity that have already proven themselves. It is common for two companies and even more to develop mutually advantageous relationships in which the waste products of one company form a valued input product for another. For example, one Nestle's plant in New York State turned toxic chocolate oil into an input for cosmetic manufacture. EIP proponents suggest that these connections can be more prevalent, purposeful and expansive. Networked manufacturing has proven a success in Europe, Australia and North America, where a common connection increases market responsiveness and reduces overhead and cost. The notions of "lean and clean" have documented that smart environmental and energy policies can lead to significant advantages (Romm, 1994). EIP advocates contend that an intelligent mixture of these manufacturing policies combined with favourable regulatory and community support mechanisms should be a formula for success.

What is an eco-industrial park?

A unique industrial ecosystem has been slowly evolving in Kalundborg, Denmark (for Kalundborg, see also the article by Robert U. Ayres in this issue of *Industry and Environment*). Located roughly 75 miles from Copenhagen, Kalundborg is a small Danish industrial area on the coast. The industrial symbiosis of Kalundborg began to evolve in the 1970s as several of the core partners, trying to reduce costs and meet regulatory demands, sought innovative ways of managing waste materials.

One of the most often cited quotes concerning Kalundborg is provided by Jorgen Christensen of Novo Nordisk. Speaking at an industrial ecology conference in Toronto, Mr Christensen remarked that "I was asked to speak on 'how you designed Kalundborg.' We didn't design the whole thing. It wasn't designed at all. It happened over time" (Lowe, 1995: 15). American businessman Paul Hawken, intrigued by Kalundborg, raised the challenge for other EIPs in *The Ecology of Commerce*:

Imagine what a team of designers could come up with if they were to start from scratch, locating and specifying industries and factories that had potentially synergistic and symbiotic relationships (Hawken, 1993: 63).

Thus the key challenge to EIP enthusiasts in North America is how to encourage similar development in new or existing industrial frameworks.

According to Ernest Lowe, John Warren and others:

An eco-industrial park is a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in managing environmental and resource issues including energy, water, and materials. By working together, the community of businesses seeks a collective benefit that is greater than the

sum of the individual benefits each company would realize if it optimized its individual performance only. . . The goal of an EIP is to improve economic performance of the participating companies while minimizing their environmental impact (Lowe and Warren, 1996: 7,8).

Industrial activity releases wastes into local, regional, and eventually global ecosystems. Since the 1970s, myriad laws and regulations have been promulgated to limit emissions to air and water and to regulate solid and hazardous waste disposal. Further, industrial activity results in non-point source pollution caused by general runoff, spills, or illegal dumping. Business and the environment have traditionally been considered natural enemies. The assumption has long been that "more environmental protection corresponds to higher costs for business;" however, new developments in research and business operations are challenging this assumption. Many companies such as 3M have long realized the economic benefits of applying environmental principles to business operations. The goal of an EIP is to minimize the ecological impact of industrial activity and to improve business performance. In the United States and Canada several projects are testing this idea.

Demonstration sites in the United States

In 1994, the PCSD designated four communities as demonstration sites for EIPs: Baltimore, Maryland; Cape Charles, Virginia; Brownsville, Texas; and Chattanooga, Tennessee. The PCSD is interested in exploring "the practical application of ecological principles to industrial activities and community design" (Wedemeyer, 1995: 2). The demonstration sites discussed below were chosen by the PCSD because of their different visions for EIP development.

Baltimore, Maryland

Located in the southeastern portion of the City of Baltimore, Fairfield is an "unlikely place to create a new environmental paradigm" (Salvesen, 1996: 29). Industry in the 2200-acre Fairfield consists primarily of producers with processes based on petroleum and organic chemicals (e.g. asphalt manufacturing and distribution, oil and chemical companies) and smaller companies which aid the larger producers (e.g. trucking, tire retreading, and box manufacturing). Fairfield has been described as a "carbon" based economy (Cornell University Work and Environment Initiative, 1995). This creates a great opportunity for further cycling of organic compounds and is one of the reasons park advocates remain confident that Baltimore will be a model for future industrial development.

The Fairfield EIP will retrofit industrial ecology principles to existing companies, help existing companies further develop and expand, and recruit companies with excellent environmental records that fit into the carbon-based economy. The strategy is to recruit the following types of enterprises: (1) manufacturing that fits with the current ecology (e.g. chemical companies, film/photo companies); (2) environmental technologies; and (3) recyclers and waste exchanges. This will help Fairfield achieve its goal of no new environmental impact, accompanied by substantial economic growth with job creation as a top priority. The plan calls for active strategies to assure high skill/high quality jobs which pay good wages and benefits.

In addition to its designation as a PCSD demonstration project, the Fairfield EIP was a central part of Baltimore's successful application for a Federal Empowerment Zone (EZ) grant that awarded over $100 million in funds and tax incentives over five years. The EZ programme is designed to create sustainable economic development in areas suffering from poverty and unemployment. The programme provides economic opportunity, sustainable community development, community-based partnerships, and planning and technical assistance. The Fairfield EIP is also a pilot project for EPA's XL for Communities initiative, a programme that is designed to "provide flexibility in the implementation of environmental regulations to communities in exchange for a commitment to achieve greater environmental performance" (US Environmental Protection Agency, 1995).

Led by the Baltimore Development Corporation and with the assistance of Cornell University, the EIP conceptual development process unfolded with extensive community participation that brought together local businesses, residents, labour unions, government agencies, investors and environmental groups through a Search Conference that sought a vision for their EIP, and a planning charrette that determined an action agenda.

Cape Charles, Virginia

Situated in Northampton County, one of Virginia's poorest counties, the Port of Cape Charles Sustainable Technologies Industrial Park is in an area plagued by poverty and unemployment. The need to revitalize this area prompted citizens to develop Northampton County's Sustainable Development Action Strategy, which has been adopted by the County Board of Supervisors. Part of the comprehensive strategy is the Sustainable Technologies Industrial Park. The 570-acre park has been custom-zoned as a Sustainable Technologies Industrial Zone and will include a coastal dune habitat preserve and wetlands for wastewater treatment.

The park's development mission is to:

1. provide a national development model that promotes business, people, economy, and natural and cultural resources;
2. create family-wage jobs and training opportunities;
3. protect and enhance natural and cultural resources, demonstrate conservation and efficient resource use, and develop and use industrial ecology principles;
4. support private businesses and industrial development, and revitalize the local economy;
5. develop the next generation of industrial facilities which combine profit, resource, efficiency, industrial ecology, and pollution prevention; and
6. increase the tax base without increasing taxes (Northampton County Department of Sustainable Development, 1995).

Northampton County hopes to maximize and sustain its assets, which include productive land, clean water, and natural and cultural resources, by targeting six key industries: agriculture; seafood and aquaculture; heritage tourism; arts, crafts, and local products; research and education; and new industry. Planners expect construction of the park to begin soon. The first company to occupy the park will be Solar Building Systems, a Swiss company which produces photovoltaic panels that convert sunlight into electricity. The recruitment aim is to attract industries that, like Solar Building Systems, have minimal emissions.

Along with PCSD designation, the Sustainable Technologies Industrial Park is within a National Enterprise Community and a Virginia Enterprise Zone. The area is also in a United Nations World Biosphere Reserve and a National Oceanic and Atmospheric Administration (NOAA) Special Management Area. William McDonough, Dean of the School of Architecture at the University of Virginia, facilitated a design charrette with the local community and government agencies to design a vision for the EIP.

Brownsville, Texas

Brownsville, the only location on the US/Mexico border with five modes of transportation, suffers from poverty and unemployment. It is home to the Brownsville Eco-Industrial Park, which also encompasses Matamoros, Mexico, Brownsville's "sister city" across the border. Planners are considering a "virtual EIP" in which industries that are not necessarily co-located would be linked through waste exchanges. The advantages of a "virtual" EIP are that businesses do not have to relocate to participate and that the concept may be more replicable than an actual EIP. New industries will be recruited to complement the existing businesses and enhance the waste exchanges. The Environmental Defense Fund suggests that Brownsville target a solvents recycler, manufacturer of recycled plastic products, and a distribution centre for reusable shipping containers (Environmental Defense Fund, 1995).

Researchers at the Research Triangle Institute (RTI) and Indigo Development have examined the Brownsville/Matamoros EIP and have focused research on the Port of Brownsville as the EIP's centre. The park also received a grant from the US Department of Commerce to refine an industry database that will be used in a computer model developed by Bechtel to match industries' by-products and wastes with other industries' input requirements. Bechtel's computer model will be the first of its kind and eventually may be commercially available. This information will facilitate the participation of existing companies by identifying opportunities for waste exchange and will aid planners in specifying what types of industries should be targeted for recruitment. The first set of potential scenarios for waste sharing should be completed sometime in the summer of 1996.

Chattanooga, Tennessee

In recent years, the City of Chattanooga has received wide acclaim as a national model for sustainable development. In 1969, Chattanooga carried the unflattering label of "America's most polluted city" (President's Council on Sustainable Development, 1996: 89). Now, nearly three decades later, the city has experienced a remarkable turnaround. Over the past decade, Chattanoogans have been engaged in a series of collaborative planning projects designed to redevelop and revitalize the City. Three years ago Chattanooga begin examining the possibility of developing an EIP.

In the original application to the PCSD, Chattanooga indicated that it would study four sites for possible EIP development.

1. **Brownfield Reclamation Park/Anchor Glass Site.** This former manufacturing site consists of 13 acres in an industrial section of Chattanooga. The property is ringed by a low-income residential neighbourhood and is close to a federal Superfund site.

2. **Mixed-Use Greenfield Park/Lookout Valley Site.** A greenfield site outside of downtown Chattanooga consisting of 755 acres, Lookout Valley is being explored as a "live/work community".

3. **Eco-Industrial Park/Volunteer Army Ammunition Plant.** This facility was owned and operated by the US Army for the production of TNT. The largest of the four sites, it consists of roughly 6800 acres. Ideas for redevelopment include warehousing, distribution, industrial activity, incubators, and a technical education centre.

4. **Environmental Technology Complex/South Central Business District.** The original vision for this site included zero-emissions industries, incubators, and housing. Ideas for the 100-acre site also include a community stadium and an urban ecology centre (River Valley Partners, 1995).

What distinguishes the Chattanooga effort is its connection to regional planning on sustainable development with a range of EIP options including ones that mix industrial, service, tourist and residential use.

Emerging projects

Beyond the PCSD demonstration sites, a number of other communities are exploring the benefits of sustainable development through EIP projects. The Green Institute in Minneapolis, Minnesota, is investigating the idea of turning three to four greenfield acres into an EIP. Similarly, a project in Tucson, Arizona, is looking to develop a greenfield EIP that would be environmentally friendly, reduce transportation, provide jobs through an integrated business community, and include industrial, commercial and residential areas. In the words of one author, "the race is on as communities across the country and around the world explore ways to redesign local manufacturing economies that are more efficient than those of the past by virtue of being gentler on the environment" (Herrick, 1995: 2).

Trenton, New Jersey

Since 1994, an Eco-Industrial Roundtable has met to discuss opportunities for eco-industrial development. The Roundtable has identified particular roles for its activities including steering, organization, research, promotion, knowledge, and match-making with prospective developers (Herrick, 1995). A number of economic development opportunities have been discussed over the past year, including greening local institutions, creating new businesses, and going after expanding or relocating companies (Herrick, 1995).

The Duwamish Coalition/Seattle, Washington

The Duwamish Coalition was formed in 1994 to address the issues of environmental remediation and economic development in the Duwamish industrial corridor, an area of land located near Seattle, Washington. For over 75 years the Duwamish Corridor has been a thriving centre of industrial activity housing industries such as steel, shipbuilding and aerospace. However, during the 1970s and 1980s the decline of many of these traditional industries had a significant impact on the Corridor as businesses closed or relocated.

The Corridor's environmental quality also has been impacted by intense industrial activity. The Duwamish Corridor currently is being studied as a potential site for the development of an EIP. The study, which should be completed by fall 1996, is examining the inputs, products, by-products and wastes of industries in the corridor and looking at matches for potential waste exchange. Industries are also surveyed about the barriers to exchanging waste and current practices for dealing with waste.

Plattsburgh Air Force Base/Plattsburgh, New York

Closed by the Department of Defense in 1995, the former Plattsburgh Air Force Base (PAFB) is being studied as a possible site for an EIP. The PAFB borders Lake Champlain and encompasses roughly 3400 acres. According to a recent document, the objectives of the proposed Plattsburgh EIP are to:

...protect and preserve the region's resources, improve the overall environmental quality of the regional eco-system, minimize impacts of future economic growth, and use the region's resources efficiently to maximize the economic return to the region (Cornell University and US Facilities Management, Inc., 1996: 7).

Many federal properties, including scores of military installations, have been decommissioned from service and will require plans for reuse and redevelopment. The PAFB will provide a model for testing EIP concepts in this arena.

Burnside Industrial Park/Dartmouth, Nova Scotia

The Burnside Industrial Park, located in Dartmouth, Nova Scotia, houses over 1200 businesses and occupies almost 2000 acres of land (Cote, Ellison, Grant, Hall, Klynstra, Martin, Wade, 1994). For the past several years, the Park has been the focus of an intense study led by Dalhousie University's School for Resource and Environmental Studies. Dalhousie activities have included a survey of Burnside businesses focusing on raw material needs, waste materials, pollution prevention opportunities, and individual perceptions; a series of articles in the *Burnside News*; and publication of a document, *Designing and Operating Industrial Parks as Ecosystems* (see the article by Theresa Smolenaars in this issue of *Industry and Environment*).

Design principles

The development of the projects outlined above has drawn on different perspectives and disciplines to help formulate their ideas. All EIPs in the US and Canada use an industrial ecology framework to help inform their development. Some, like the Chattanooga proposal, draw heavily on urban and land use planning that has been used in economic development and recruiting. Others are more engineering driven, seeing the possibilities of creating pipe-to-pipe interconnections. This perspective recognizes new technological possibilities, especially in the development of connecting technologies that support regional industrial recycling. The goal of "zero emissions" seeks an engineered connection which by design minimizes and reuses waste.

Yet another perspective is based in business trends that seek greater interconnection between suppliers, producers and customers for high quality performance. These design principles are not mutually exclusive, but inform thinking about EIP development. The paragraphs below elaborate on certain "design drivers" for EIP projects.

Industrial ecology

Industrial ecology is an emerging field of thought that models industrial systems after ecological systems. In natural systems, very little is wasted: *Plants transform water, carbon dioxide, and sunlight into sugars, and these sugars are broken down by other species. . . over a period of four billion years there have always been niches for organisms that could make use of underutilized chemical pathways, [and] as these niches have filled, an extraordinarily efficient system of nutrient cycling has developed* (Van Der Ryn and Cowan, 1996: 106-107).

In 1989, the concept of an "industrial ecosystem" received wide attention when *Scientific American* published an article by two General Motors researchers who suggested that the days of finding an "open space beyond the village gates" for the by-products of industrial activity were quickly fading (Frosch and Gallopoulos, 1989: 144). Since that time, the concept of industrial ecology has spawned an ever increasing amount of research and activities. At the most basic level, industrial ecology describes a system in which one industry's wastes (outputs) become another's raw materials (inputs). Within this "closed loop" fewer materials would be wasted. Thus, "if businesses were able to turn waste into food, they could sharply reduce pollution and the need for raw materials" (Van Der Ryn and Cowan, 1996: 107).

Many industries have long had symbiotic relationships in which wastes and materials are transformed internally or by others. For example, metal industries have long used scrap materials in the production process. The advent of the electric arc

Box 1
Technologies supporting eco-industrial parks

1. Information technologies. New information technologies such as the World Wide Web will be invaluable to EIPs. Access to information can assist park participants in developing possible supplier/customer relationships for by-products. It can also assist in marketing efforts external to the actual park.

2. Water. Reuse of water offers a substantial benefit to participants in an EIP. Because many firms use large amounts of water in manufacturing, collaborative efforts can reduce the need for water and minimize the amount of effluents entering water treatment systems and the eco-system.

3. Energy. Beyond recycling and reuse technologies, energy technologies seem to receive the most attention in discussions of EIPs. Three energy technologies seem most appropriate for EIPs: cogeneration systems, energy recovery processes, and alternative sources.

4. Recovery, recycling, reuse and substitution. Much of the attention given to environmental technologies for EIPs swirls around the development of new processes for reusing wastes and by-products. Central to an EIP's ability to exchange wastes and materials will be conversion or separation technologies capable of preparing former wastes for other uses.

5. Environmental monitoring. As the regulatory system continues to evolve with new government initiatives such as XL for Communities, Startrack, the Common Sense Initiative and various voluntary programmes including Energy Star, Waste Wise, and 33/50, effective environmental monitoring technologies will be essential. Monitoring technologies will provide information to regulators and the public about industrial performance, and to a certain extent alleviate some of the problems that could arise from joint-permitting. Finally, monitoring technologies are the tool by which EIP participants and others can judge how well the EIP's environmental programmes are working.

6. Transportation. The transportation sector is a major contributor to a number of environmental problems, including non-point source pollution and air emissions such as greenhouse gases. New means of moving people and goods throughout and beyond an EIP will be essential to lowering the overall environmental impact of an EIP. Examples might include using clean-burning alternative fuel vehicles or electric vehicles, or the application of sophisticated logistics management systems such as just-in-time delivery of goods and services.

furnace has increased the ability of steel manufacturers to use scrap materials. Petrochemical and chemical companies are adept at finding new production uses or markets for waste materials (Richards, Allenby and Frosch, 1994). The growth in rubber, plastics, paper and glass recycling has generated new uses for previously discarded materials.

As Ernest Lowe suggests, industrial ecology:

is a broad holistic framework for guiding the transformation of the industrial systems. This will be a shift from the linear model (mine pit to producer to consumer to dump) to a closed-loop model more closely resembling the cyclical flows of ecosystems . . . it has stimulated new ways of thinking in a scattering of companies, in a number of major and minor universities, and in agencies like the US Environmental Protection Agency and Department of Energy (Lowe, 1995: 1).

Despite its intuitive appeal, many uncertainties associated with industrial ecology remain to be explored. Just as natural systems are infinitely complex, industrial ecosystems are complicated. Current regulatory structures, information deficiencies, and managerial cultures are impediments to widespread adoption of industrial ecology principles.

Brownfield redevelopment

"Brownfields", or abandoned, usually urban sites with actual or perceived contamination, are an enormous problem for US cities. These sites are often not redeveloped because prospective buyers and lenders are wary of the liability associated with ownership of contaminated property. This drives developers towards "greenfields" or previously undeveloped areas, which enhances urban sprawl, diminishes natural resources, and leaves the community with obsolete properties.

EPA's Brownfields Economic Redevelopment Initiative awards $200,000 over two years for brownfields redevelopment pilot projects (some of these awards have been for less than $200,000). Sixty-two pilot projects have been awarded. The Conference of Mayors considers brownfields to be of such importance that it created a Brownfields Task Force. They found that brownfields exist in cities of all sizes, are diverse in size, negatively impact the community and its resources, and result in vast losses of local tax revenues (United States Conference of Mayors, 1996).

EIPs are an appealing redevelopment option for brownfields because they offer the community sustainability, economic growth, and lower environmental impact than traditional industry. They often offer industry proximity to existing industrial centres and access to transportation. The overlap between brownfields redevelopment and EIP development can be seen in the EIP efforts which are also pilot projects for EPA's Brownfields Initiative. Baltimore, Cape Charles, Burlington, Duwamish Coalition, Rome (New York) and Trenton are all brownfields pilot projects and have EIP or related efforts.

For example, Baltimore's brownfields project coordinator and the Fairfield EIP project manager are working together to address brownfields located within the EIP core area. Brownfields within the park are categorized in two ways: level of contamination, and ownership. Each parcel is assigned a colour based on its level of contamination: green for no or very minimal contamination, yellow for minor contamination, and red for heavy contamination. The land is also categorized according to ownership: city, public, state, private, industry, etc. "Green" city- and state-owned land likely would be the easiest to redevelop.

The Port of Cape Charles Sustainable Technologies Industrial Park has about 150 acres of brownfields out of a total 570 acres. The centre of this park will be a redeveloped brownfield. As the Clinton Administration pushes forward with brownfield redevelopment, a critical question once liability and remediation issues are resolved will be what kinds of economic development are built on reclaimed brownfields. EIPs are likely candidates for many redeveloped properties.

Business development and networked manufacturing

A successful EIP must demonstrate its capability in the marketplace. At Cornell we have emphasized the importance of high quality, high performance organizations. At the operational level this requires a total system approach to resource utilization, not merely focusing on particular chemicals or energy sources. Valuing natural resources in a company must be accompanied by valuing its human resources. This means total engagement of the workforce in achieving environmental excellence and a strong sense of responsibility and partnership with the surrounding community. Research conducted at Cornell demonstrates that in US firms source reduction was three to four times higher in companies with broad internal participation than in those who relied on technology and outside sources alone (Bunge, Cohen-Rosenthal and Ruiz-Quintanilla, 1995).

Cornell research has led to a goal which suggests that at minimum EIP companies can operate 20-30 per cent over industry average on return on assets (ROA). The research suggests that this is achievable especially in resource-intensive industries when industrial ecology economies reduce input resource and disposal costs, high performance work leads to higher efficiencies, and networked collaboration from maintenance to training to environmental reporting cuts costs and increase capability.

At the market level, the environmental concern demonstrated in an EIP should translate into more business. In the United States, procurement by government and corporations of environmentally preferable products is a growing practice worth many billions of dollars. EIP businesses are poised to capture this growing market. In addition, environmental image enhancement should enhance sales. By emphasizing cost containment along with environmental excellence, producers in EIPs should be able to capitalize on the vast market of consumers who will make a choice for environmentally conscious products given price

comparability. In other words, the EIP market aims at the mainstream, not just an ecologically devoted niche.

New technologies and EIPs

Recent decades have seen the emergence of markets for innovative environmental technologies and clean green products. Spurred by the need for new processes to meet the ever growing number of regulations, new technologies have helped industry and government develop substitutes for scarce or toxic materials. Moreover, the massive clean-up requirements of Superfund sites and federal projects have resulted in the development of many new remediation technologies.

According to a recent document, *Bridge to a Sustainable Future*, the market for environmental goods and services is tremendous. The United States is the largest market for the environmental industry, generating almost $150 billion in business annually and employing nearly one million people. In the United States, federal support of environmental technologies was nearly $4 billion in 1994. Worldwide, the market for environmental goods and services approaches $300 billion and is expected to grow to between $400 and $500 billion by the end of the century (Interagency Environmental Technology Office, 1995). A 1993 report published by the Office of Technology Assessment suggests the possibility of incremental changes in the environmental industry market in the coming decade.

1. The industrial market for environmental equipment is likely to be greatly affected by a shift away from conventional pollution control to pollution prevention and cleaner production processes. This shift, now in its early stages, will have repercussions for environmental companies and manufacturing firms. . . Manufacturing firms that use such processes are likely to reduce compliance costs and in some cases production costs;

2. New forms of regulations allowing firms to adopt innovative approaches for addressing pollution can help both developers and users of environmental technology. These include performance standards, economic incentives, and the adjustment of permitting procedures to stimulate the development and adoption of innovative environmental technologies (US Congress, Office of Technology Assessment, 1993: 2-3).

EIPs offer a unique opportunity to stimulate new technologies to fit the need of a particular location. Martin et al. suggest that an "EIP can provide the incentive and the opportunity to think more systematically about technology and how it can best be applied" (Martin, Sharma and Lindrooth, 1995: 1). Moreover, Martin et al. (1995) identify several broad categories of environmental technologies suitable for EIPs (see **Box 1**).

The future

Some future trends are predictable: concern for the environment will grow; resources will become more scarce and less reliable; demands for quality and cost competitiveness will increase. These challenges can be overcome with a new paradigm of industrial organization that asks each community, each company, and each employee how they work together to use resources more wisely. The development of EIPs can create good jobs, strong companies, sustainable communities, and improved regional environments. ◆

Industrial ecology and the role of the Cleaner Production Centre

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Abstract

The Burnside Cleaner Production Centre was established in March 1995 to provide information on waste reduction, pollution prevention, and cleaner production to businesses in the Burnside Industrial Park, Dartmouth, Nova Scotia, and to examine the application of industrial ecology concepts to an existing industrial park. Several factors can influence the successful application of the industrial ecology concept. The effective marketing of the concept to businesses in the park is essential. Regulations can be used to influence what materials are used and disposed of within the park. Moreover, businesses should be better educated and symbiotic relationships should be encouraged. A Cleaner Production Centre can play a pivotal role as a park moves towards an ideal industrial ecosystem.

Résumé

Le Burnside Cleaner Production Centre a été créé en mars 1995 pour fournir des renseignements sur la réduction des déchets, la prévention de la pollution et une production plus propre aux entreprises du parc industriel de Burnside, à Dartmouth, Nova Scotia au Canada ,et pour examiner l'application du concept d'écologie industrielle à un parc industriel existant. Plusieurs facteurs peuvent influencer le succès de l'application d'un concept. Sa promotion réussie auprès des entreprises du parc est primordiale. On peut avoir recours à des règlements afin d'influencer les choix de matériaux employés et mis au rebut au sein du Parc. De surcroît, il convient de mieux éduquer les entreprises et de promouvoir des relations harmonieuses. Un centre pour une production plus propre peut agir comme une plaque tournante au fil de l'évolution d'un parc vers un écosystème industriel idéal.

Resumen

El Centro de Producción más limpia Burnside se creó en Marzo de 1995 para brindar información a las empresas del Parque Industrial Burnside, en Dartmouth, Nova Scotia sobre la reducción de desechos, la prevención de la contaminación y una producción más limpia y para examinar la aplicación de los conceptos de ecología industrial en un parque industrial existente. Varios factores pueden influir en la aplicación exitosa del concepto de ecología industrial. Es esencial un marketing *eficaz del concepto, dirigido a las empresas del parque. Se puede emplear las reglamentaciones para influir sobre qué materiales se usan y desechan en el parque. Además, se puede educar mejor a las empresas y estimular las relaciones simbióticas. Un Centro de Producción más limpia puede jugar un papel esencial cuando un parque se dirige hacia un ecosistema industrial ideal.*

Industrial ecology and industrial ecosystems

The premise of industrial ecology is that the industrial economy – that system of raw materials extraction, manufacturing processes, product use, and waste disposal – should mimic the cycling of materials in the natural ecosystem as much as possible. For an industrial park to function as an ecosystem there must be a flow of materials, energy and wastes between businesses which can make efficient and effective use of them.

The underlying concept of industrial ecology was described in a seminal article by Frosch and Gallopoulos in 1989. They stated that:

the traditional model of industrial activity, in which individual manufacturing processes take in raw materials and generate products to be sold plus waste to be disposed of, should be transformed into a more integrated model: an industrial ecosystem. In such a system the consumption of energy and materials is optimized and the effluents of one process, whether they are spent catalysts from petroleum refining, fly and bottom ash from electric power generation or discarded plastic containers from consumer products, serve as raw materials for another process (Frosch and Gallopoulos, 1989).

In ecosystems, materials flow cyclically from producers (plants) to consumers (animals) and are recycled by decomposers (fungi, microbes) and scavengers (vultures, hyenas, and so on). Everything is put to use and the concept of waste is meaningless. In human industries, by contrast, materials move in a linear fashion from manufacturer to consumer and then straight into the air or into a dump. "Waste" is essentially a meaningless human invention (Schmidt, 1996).

Human settlements and industrial parks are viewed as having some things in common with natural ecosystems in terms of energy and material flows. By looking at an industrial park as a unit and analysing the pathways along which energy and materials move, we can begin to investigate how the consumptive and waste generating activities can be reorganized and integrated with each other and natural processes to increase the efficiency of resource use, and the recycling and recovery of wasted materials and energy. In doing so, we can lessen the impact of industry on the environment (Côté et al., 1994).

In ecological terms, businesses that exchange inefficiently used materials have entered into a symbiotic relationship. Symbiosis is an arrangement where two or more unlike organisms live together or collaborate in ways that are beneficial for both. Symbiotic relationships among businesses are often referred to as industrial symbiosis (Reid, 1995). Kalundborg, an industrial city in Denmark, is perhaps the best known example of industrial ecology in practice. For 15 years participating industries have used by-products from other industrial operations as raw materials for their operations. Examples of materials exchanged include oil, coal, water, carbon dioxide, sulphur dioxide, fly ash, sulphur, gypsum, nitrogen and phosphurous (for Kalundborg, see also the article by Robert U. Ayres in this issue of *Industry and Environment*).

Many companies have begun to realize that the elimination, reuse and recycling of wasted energy and materials could lead to cost savings. While internal pollution and waste prevention can make a significant impact on operating and disposal costs for companies, there will remain residual materials that can be turned into a profitable new resource rather than a disposal cost. This can be accomplished through a system of closed loop recycling (chains and webs of businesses) within the industrial system in which the business exists. The goal is to cycle the maximum amount of waste and other potential input by-products to other participants in the industrial ecology system.

The Burnside Industrial Park

Our research and development project is investigating the potential for establishing such ecosystems using the Burnside Industrial Park as a test site. Burnside Industrial Park was established 25 years ago in a commercial and light industrial zone designated in the municipal development plan of the city of Dartmouth, Nova Scotia, Canada. The park encompasses 1200 hectares, of which 760 are

now occupied by various businesses. The park is composed of mainly small or microscale businesses (less than 20 employees). This differentiates the study from other industrial ecology projects such as Kalundborg or Brownsville, Texas, which focus on large businesses (Côté et al., 1994).

Burnside has approximately 1300 businesses from dozens of different sectors. In terms of redundancy, the park has 18 printers, 21 painting and paint distribution firms, 17 chemical companies, 20 computer assembly and repair businesses, 25 automotive repair facilities, and 17 metal processing companies. Among larger companies, the park encompasses a furniture manufacturing company, plastic film and cardboard manufacturing companies, and a telecommunications firm. The industrial park also contains a wide variety of businesses in the food services, health services, communications, construction, retail and transportation sectors.

A survey of 278 businesses in the Burnside Industrial Park was conducted in 1992. Results indicate that many businesses support waste utilization and the concept of industrial ecology:

- 92 per cent of business people supported opportunities to make use of their waste for productive and environmentally acceptable activities;
- 90 per cent were willing to participate in cooperative waste reduction mechanisms;
- 90 per cent wanted more information on efficiency and waste minimization possibilities.

Business people also indicated that economic incentives, financial assistance, and information were most likely to influence their decisions to change materials and energy usage, as well as production processes (Côté et al., 1993).

The Burnside Cleaner Production Centre

The Burnside Cleaner Production Centre was established in March 1995 to provide information on waste minimization, pollution prevention and cleaner production to businesses in the Burnside Industrial Park. The Centre also examined the application of industrial ecology concepts and principles to an established industrial park. It was situated in the Park, in a location that was easily accessible by all business people. The Centre was staffed by two full-time research associates and several students, who were available to conduct waste assessments and answer questions posed by businesses. Business managers were given access to a library of over 1000 publications on waste minimization, pollution prevention and cleaner production. These publications, gathered from a wide variety of sources throughout the world, included books, articles, videos, CD-ROMs and software.

One of the main goals of the Centre was to transfer this information to businesses in the Park in a timely and easily accessible manner. There are many barriers to the transfer of environmental information to small and medium-sized businesses, including:

- the belief that pollution reduction is always a cost and never a savings;
- ignorance of compliance regulations;
- lack of awareness of environmental issues;
- lack of managerial and technical background to deal with these issues;
- lack of time or money;
- orientation to sales maximization rather than cost minimization;
- innate conservatism and reluctance to accept change.

The Centre used a variety of methods to transfer information about waste reduction, pollution prevention and cleaner production to businesses in the Park. It distributed informational brochures to companies in the environment industry. These companies were asked to distribute the brochures to their customers. The Centre also faxed two informational flyers about the Centre and its services to approximately 800 businesses in the Park. Over the course of the year the Centre staff held meetings with various business leaders in the Park who had an interest in the environment. The Centre also presented information to committees who dealt with issues related to the Park. One of the unique features of the Park is a monthly newspaper, *The Burnside News*. The project team wrote a monthly column in the paper entitled "The Burnside Ecosystem". This column was used to provide information on topics related to industrial ecology and pollution prevention, as well as the status of the project and services offered by the Centre.

The Centre met with businesses in a wide range of industries and with a variety of concerns with respect to waste reduction and environmental management. Most of these businesses lacked the basic information necessary for the development of an environmental management plan. Most businesses did not know which laws and regulations applied to their business and did not know how to find this information. Most suppliers do not provide enough information to allow businesses to make environmentally conscious decisions. As well, most businesses do not have basic information on reduce, reuse, recycle, refurbish and remanufacture options.

The Centre used a variety of methods to address the concerns expressed by businesses. It developed a set of 20 "Waste Minimization Fact Sheets" on a variety of subjects relevant to businesses in the Park. Examples include "Office Waste Management," "Packaging Waste Management," and "Environmentally Friendly Purchasing Policies." These Fact Sheets provide basic information on reduce, reuse and recycle options available to businesses in the Park. The Centre also developed a booklet, "Burnside: Putting the 5Rs Into Action," which contains information on companies in and around Burnside involved in the reduce, reuse, recycle, refurbish and remanufacture industries. The goal was to provide businesses with a variety of options in terms of environmental management. The Centre also attempted to foster better relations between businesses and suppliers and businesses and the provincial Department of the Environment.

The waste assessment was one of the focal points of the Centre. Each waste assessment examined a company's inputs, processes, outputs and waste materials to determine ways in which materials could be used more efficiently and waste reduced. The Centre also answered questions posed by business managers with regard to waste minimization, pollution prevention, and alternatives to disposal of their waste products. The staff of the Centre conducted waste assessments with over 40 companies in the following industries:

- the printing industry;
- the computer assembly and distribution industry;
- the electronics sales and service industry;
- the vehicle maintenance industry;
- the chemical manufacturing and distribution industry;
- the paint and coatings industry;
- the metal processing industry.

Encouraging businesses to participate in a waste assessment was the governing factor in the success of the Burnside Cleaner Production Centre. Not all companies view an assessment as a beneficial means of becoming an environmentally conscious facility. It is considered by some to be a time-consuming and costly procedure that interrupts production, requires extra effort and personnel to manage, and may require changes to currently acceptable business practices. Nor do all companies recognize that they contribute to the overall environmental impact of the Park. Businesses were originally sent an introductory letter and environmental information relevant to their industry. This was followed by a telephone call or visit, with the business being asked to participate in a waste assessment. The participation rate varied by industry, with an overall rate of approximately 40 per cent.

The following reasons were given as to why businesses did not wish to participate in a waste assessment:

- The manager also functioned as a production employee and did not feel that he/she had enough time to have an assessment conducted.
- The company did not feel it had enough waste to warrant an assessment.
- The company did not view waste reduction as a priority; it was only concerned with staying in compliance with regulations.
- The company believed that it was doing all that it could to reduce waste.
- The manager was not interested in the environment.
- The manager did not have enough time to consider participating in an assessment.

Material chains and webs

One of the fundamental characteristics of natural ecosystems is the existence and maintenance of food chains and webs. In an operating industrial ecosystem, product and decision-making chains and webs also play important roles. Policies and mechanisms must be adopted to facilitate these chains and webs. The importance of these chains has already been recognised by the development of tools to assist the decision-making process.

The effective functioning of the industrial park ecosystem will depend on the flow of materials within the park and the surrounding community.

The information management system must facilitate the flow of energy and materials. Although one integrated system would be preferable, it is likely that a network of mechanisms would be required to encourage the greatest possible use of waste and secondary materials. In Burnside, we are proposing four focal points or centres linked to the information management system, ECOPARK. These focal points address materials of different types and in different quantities.

The Burnside Industrial Park case study indicates that the material wasted in the greatest quantity is packaging. Packaging can be defined as any material or item that is used to protect, contain or transport a commodity or product. Packaging is wasted when companies receive products and materials, when they prepare goods for shipment and sale, and when they move products and materials within their facility. Much of this packaging can be reused as is or can be modified for reuse. A "Centre for Packaging Reuse" has been proposed for the Burnside Industrial Park that would organize and modify packaging materials made from cardboard, plastic, wood, glass, metal and polystyrene for reuse. The purpose of the Centre would be to gather and redistribute packaging materials from within the Park. This is the first focal point of the ECOPARK materials management system.

A used building materials facility is proposed within the Park to make used building materials and fixtures available to developers within the park, as well as the wider community. The provincial government has imposed a landfill ban on construction debris, resulting in the establishment of several local recyclers of construction debris. A used building materials facility could be linked to one that handles this debris. This is the second focal point of the ECOPARK materials management system.

There are a large number of businesses which generate small quantity waste materials readily reused by the arts community and the school system. For example, computer and electronic firms generate wasted wires, circuit boards, foam sheets, and plastic and metal components, all of which are used by the artistic community. A "Centre for Creative Reuse" is proposed which would make these materials available to artists and teachers at a minimal cost. This is the third focal point of the ECOPARK materials management system.

Finally, a chemical exchange designed primarily to handle small quantities of wasted chemicals is proposed. This should reduce the overall quantity of chemicals shipped long distance for hazardous waste disposal or disposed of in the sewer system. This service already exists within the metropolitan area, although its focus has primarily been universities and hospitals. It could be extended for use by companies in the Park. The service could also be extended to encompass such materials as wasted paints and oil. This is the fourth focal point of the ECOPARK materials management system.

Recommendations for other industrial ecosystems

Creating an ideal industrial ecosystem in the Burnside Industrial Park could be considered an impossible task. However, this study has shown that it is possible to modify existing conditions in the Park to substantially improve waste minimization programmes and to move the Burnside Industrial Park closer to a self-sustaining industrial ecosystem. Several factors will influence the adoption of this concept by the Park. These factors can also be used by other industrial parks who wish to move in this direction.

The effective marketing of the industrial ecology concept is essential to establishing its credibility. Businesses have been bombarded with "Save the Environment" messages over the last decade. Most businesses do not relate to this concept. Most focus on remaining competitive over the short term and are often too busy to commit to an environmental programme unless a strong incentive is provided to them. The industrial ecology concept promotes waste minimization as a method whereby businesses can achieve cost savings and decrease their impact on the environment. These concepts must be presented to industry as a business opportunity rather than a "Save the Environment" opportunity. Creating positive public attention towards the concept will help increase its acceptance by the business community.

Regulatory issues play a role in the success of an industrial ecosystem. Government should implement more pro-active measures to control what materials are being used and disposed of by industry. Regulations should be put into place to discourage businesses from using hazardous and toxic materials that have proven and feasible alternatives. The disposal of materials should be regulated more thoroughly, and many materials should be banned from landfill disposal. Transportation of hazardous material regulations should be modified to allow for the easy transfer of waste materials between business. This will increase the flow of materials between businesses, with more wasted materials being used as inputs.

The business community must also be better educated and provided with more information on waste minimization and pollution prevention opportunities available to their business. Businesses need easy access to information such as case studies, waste minimization fact sheets, laws and regulations, and information on companies in the reduce, reuse, recycle, refurbish and remanufacture industries. Businesses must be better educated about the financial and environmental benefits of a waste minimization programme.

There are many opportunities for businesses in the Park to form symbiotic relationships to reduce waste. There are also many opportunities for businesses to be established that could facilitate reuse of materials. These opportunities could be developed into fully functioning businesses or could be managed by a Cleaner Production Centre, using the ECOPARK concept. A Cleaner Production Centre could be designed to coordinate and house the data for environmental services and waste exchanges while at the same time providing information on waste minimization options to businesses in the Park.

Because we cannot yet claim that an industrial ecosystem has been established in Burnside Industrial Park, we have developed a multi-faceted educational approach to disseminate information on the concept, tools and resources available. This approach is designed to facilitate the implementation of an ecosystemic or eco-efficient operation. *Eco-efficiency* is the term used by the Business Council on Sustainable Development as a synonym for sustainable industrial development. Our approach has included workshops, sectoral and cross-sectoral consultations, training sessions on cleaner production assessments, audits, a newspaper column on aspects of industrial ecology, waste minimization fact sheets, a waste reduction fair, and applied thesis research by students.

In the short term, the educational programme is focusing on property managers, the owners or managers of operating businesses, and the technical manager or supervisors. In the long term, university and technical institute students must be taught to think in terms of waste minimization, cleaner production and industrial ecosystems, because they are the people who will design, build and operate industrial parks in the future. Their direct involvement through analysis of case studies, group projects, site visits and thesis research will enhance classroom teaching.

Conclusions

The Burnside Cleaner Production Centre was designed to provide information on waste reduction, pollution prevention, and cleaner production to businesses in the Burnside Industrial Park. The Centre also examined the application of industrial ecology principles to an existing industrial park. The work of the Centre has shown that most small and medium-sized businesses lack the basic information needed to develop an environmental management plan and to reconsider the way in which they deal with their waste. Most businesses were receptive to the Centre once the barriers to information transfer were overcome. However, change does not happen quickly. Many businesses have begun to implement basic changes which will decrease the overall environmental impact of the Park. But for the Burnside Industrial Park to operate as an industrial ecosystem, there must be a long-term commitment from Park management. A coordinating group, such as the Burnside Cleaner Production Centre, is needed to implement the ECOPARK model and promote change within the Park. The integrity of the park will be enhanced and a transformation of the industrial system will occur.

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The monitoring system for industrial estates in Thailand

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Abstract

Thailand's economic growth during the last decade has been around 8 per cent. Its major export has changed from agricultural to industrial products. Pollution control is of major concern. The Pollution Control Department of the Ministry of Science, Technology and Environment is responsible for pollution control in general; the Industrial Works Department is responsible for industrial pollution control, except in the case of factories on industrial estates. The Industrial Estate Authority of Thailand (IEAT) carries out its own pollution control and environmental management, including a monitoring system for industrial estates.

Résumé

Au cours des dix dernières années, la Thaïlande a connu une croissance économique de l'ordre de 8 pour cent. Ses exportations ont basculé au détriment des produits agricoles vers les produits industriels. Le contrôle de la pollution est une préoccupation majeure. Le Département pour la Lutte contre la Pollution du Ministère des Sciences, de la Technologie et de l'Environnement est chargé du contrôle de la pollution dans son ensemble. Quant au Département des Travaux Industriels, il est plus spécialement chargé du contrôle de la pollution industrielle, hormis dans le cas des usines situées en zones industrielles. C'est à l'Autorité des Zones Industrielles de la Thaïlande d'assurer son propre contrôle de la pollution et la gestion de l'environnement, y compris la mise en place d'un système de suivi des zones industrielles.

Resumen

El crecimiento económico de Tailandia durante la última década ha sido de cerca del 8 por ciento. Su exportación principal ha cambiado de la agricultura a los productos industriales. El control de la contaminación es una preocupación fundamental. El Departamento de Control de Contaminación del Ministerio de Ciencias, Tecnología y Medio Ambiente se encarga del control de la contaminación en general; el Departamento de Trabajos Industriales se encarga del control de la contaminación industrial, salvo en el caso de fábricas en emplazamientos industriales. La Autoridad de Emplazamientos Industriales de Tailandia (IEAT) lleva a cabo su propio control de la contaminación y gestión medioambiental, que incluyen un sistema de supervisión de los emplazamientos industriales.

Background

IEAT is a state enterprise attached to the Ministry of Industry (see **Appendix A**). It was founded in 1972. IEAT was chartered to promote systematic industrial development in accordance with the zoning system and environmental protection. It has developed and decentralized industrial estates in the regions, in harmony with the National Economic and Social Development Plan. At present there are 23 industrial estates with 1200 factories, as shown in **Table 1**.

IEAT's philosophy

Economy

IEAT is one of the government's potential means of attracting capital investment from overseas and is the mechanism of industrial decentralization. The 23 industrial estates are located in twelve provinces and in three economic zones (**Figure 1**). Capital investment is 450,000 million bahts, with 400,000 persons employed.

Table 1
Industrial estates and number of investors

N°	Industrial estate	Location	Number of investors
1	Bangchan	Bangkok	74
2	Ladkrabang	Bangkok	147
3	Gemopolis	Bangkok	46
4	Bangplee	SamutPrakarn	122
5	Bangpoo	SamutPrackarn	258
6	Laem Chabang	Chonburi	80
7	Bangpakong	Chonburi	36
8	Chonburi	Chonburi	5
9	Map Ta Phut	Rayong	43
10	Eastern	Rayong	17
11	Eastern Seaboard	Rayong	-
12	Padaeng	Rayong	1
13	Northern Region	Lumphun	61
14	Wellgrow	Chachoengsao	140
15	Gateway City	Chachoengsao	5
16	Hi-Tech	Ayudhaya	13
17	Bangpa-in	Ayudhaya	49
18	Saharattana Nakorn	Ayudhaya	28
19	Saraburi (Kaengkoi)	Saraburi	-
20	Nong Khae	Saraburi	3
21	Samutsakorn	Samutsakorn	60
22	Pichit	Pichit	-
23	Southern	Songkhla	-
	Total		**1,188**

Equitability

IEAT has promoted social equitability in terms of responsibility and obligation. Industrial operators must be responsible for the social and environmental impacts of industrial operations. They should also provide contributions for social development and environmental protection.

Environment

An industrial estate is a systematic factory establishment or relocation – a mechanism capable of mitigating environmental impacts. All industrial estates provide central facilities for pollution control (**Tables 2 and 3**). Furthermore, IEAT has implemented monitoring systems and enforcement for all industrial estates in order to protect the environment and promote sustainable development.

Education

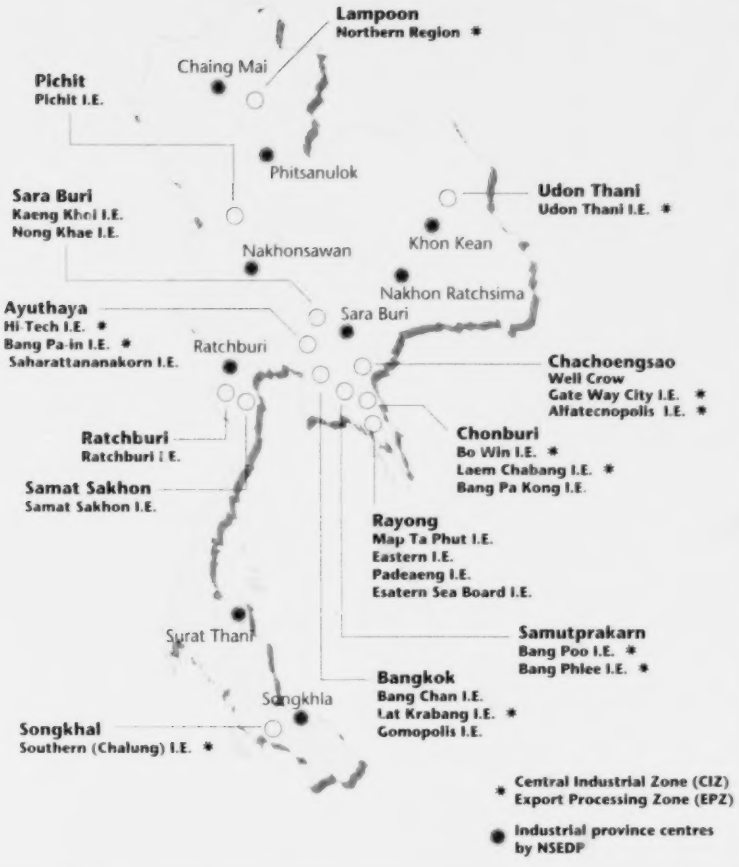
In the new era of IEAT, education will be promoted and academic institutes will be set up for unskilled and skilled workers, staff and the public, such as the Ayuthaya Technical Training Centre at the Hi-Tech industrial estate. Several industrial estates are trying to achieve this objective and continue to enhance themselves in order to become "Science Parks", where an academic institute and a research and development centre would be expected to be found.

Ethics

IEAT promotes ethics in business administration and public responsibilities. Industrial operators must follow the enforcement and regulations for their image and reputation.

Establishment of the industrial estate begins with site selection, an environmental impact study, infrastructure development (i.e. road, water supply system, electricity, central wastewater treatment facilities, sewer system, storm water drain-age system), incinerator, and landfill for ash. IEAT has to submit an environmental impact assessment to the Office of Environmental Policy and Planning, Ministry of Science, Technology and Environment (OEPP, MOSTE) for approval before infrastructure is constructed. IEAT has also set up pollution control measures for air, water and hazardous waste management which include environmental quality monitoring programmes and the monitoring of the facilities of all industrial estates, as part of an EIA report.

Figure 1
Existing Industrial estates



Monitoring programmes

Wastewater monitoring

All industrial estates provide central wastewater treatment facilities. Discharge of industrial wastewater to central treatment systems must comply with IEAT's criteria, as shown in **Appendix B-1**. If the wastewater exceeds these criteria, the factory must have a pre-treatment system. The effluent of the central treatment systems must conform to the standard of the Ministry of Science, Technology and Environment (MOSTE), as shown in **Appendix B-2**.

Monitoring of individual discharges to the central treatment systems and central effluent has been carried out by IEAT's contractor, B.J.T. Water Co., Ltd., a joint venture since 1994 between Thames Water and Berli Jucker under the supervision of IEAT's staff.

Wastewater analysis

All industrial estates have set up laboratories to analyse wastewater characteristics, conducted by B.J.T. Water Co. under the supervision and control of EAT. The services are as follows:

- checking the quality of wastewater discharged to central treatment plants according to EAT's criteria, such as pH, BOD, SS, DS. The analytical reports are used for calculating the wastewater treatment charges. Sampling occurs at least twice a month. The waste maintenance key performance report is recorded for each site monthly.
- checking the quality of central effluent according to MOSTE's Standard (e.g. pH, BOD, SS, DS), as well as checking the efficiency of the central treatment facilities. The sampling frequency is at least four times a month.

Verification of wastewater analysis

Some factories in the industrial estates have their own laboratories. These factories take wastewater samples at the same time as the B.J.T. Water Co., to verify the company's analytical reports.

Where there is no laboratory, the factories send the concurrent samples to the service laboratory in order to verify B.J.T. Water's analytical reports.

Air pollution monitoring

Any factories which have to submit EIA to OEPP have to monitor stack emissions and ambient air according to the EIA requirement and report the monitoring results to OEPP.

Hazardous waste monitoring

Factories in the industrial estates have to monitor hazardous waste transportation, storage and landfill (if any) according to the Ministry of Industry's Notification No. 25 B.E. 2531. If the factories have contractors that handle hazardous waste management, the industrial operators must report to IEAT the contractor's name and qualifications, method of disposal, disposal and landfill site, and quality and type of wastes in the case of each transfer.

Monitoring of the industrial estate environment

At present there are 23 industrial estates under

Table 2
Summary of wastewater treatment systems

Industrial estate	Type of system	Capacity (m^3/d)	Capital cost (million baht)	Year
1. Bangchan	activated sludge	4,000	135.00	1996
2. Ladkrabang	activated sludge	20,000	103.76	1979
3. Bangplee	activated sludge	8,000	64.54	1986
4. Bangpoo	aerated lagoon/rbc	22,000	13.98	1980
5. Northern Region	aerated lagoon	5,600	25.50	1986
6. Map Ta Put	activated sludge	4,000	30.94	1989
7. Laem Chabang	activated sludge	20,500	257.53	1991
8. Bangpakong	aerated lagoon	11,300	94.85	1992
9. Hi-Tech	activated sludge	16,800	143.19	1992
10. Bangpain	activated sludge	6,000	157.53	1994
11. Gateway City	activated sludge	37,229	190.00	1994
12. Bangpoo (Phase A)	activated sludge	3,600	108.30	1994
13. Samut Sakhon	activated sludge	22,000	218.08	1991
	chemical treatment	2,000		
14. Chonburi (Bowin)	activated sludge	6,400	130.82	1992
15. Saraburi (Kang Koi)	activated sludge	8,000	75	-
16. Nong Khae	activated sludge	12,000	88	-
17. Eastern	activated sludge	12,000	75	1994
18. Wellgrow	aerated lagoon	7,200	79.76	1994
19. Saharattananakohn	activated sludge	8,000	80	1995
20. Gemopolis	activated sludge	2,000	20	1992
21. Songkhla (Chalung)	activated sludge	3,000	61.23	-
22. Pichit	aerated lagoon	9,200	31.7	-

Table 3
Summary of solid waste systems

Industrial estate	GIZ		EPZ		Truck	Capital cost
	Incinerator (No./Cap./kg:h)	Landfill (rai)	Incinerator (No./Cap./kg:h)	Landfill (rai)	No./cu.m.	(million baht)
1. Bang Chan	M	-	-	-	-	-
2. Bang Poo	M	-	1/250	-	1/12	13.95
3. Lat Krabang	1/500	-	2/250	-	1.8	1.25
4. Bang Plee	M	-	-/-	-	-	4.12
5. Map Ta Phut	-/-	9	-/-	-	1/4	9.26
6. Laem Chabang	-/-	9	-/-	-	1/4	9.6
7. Northern Region	-/-	-	1/250	-	1/1	1.25
8. Samushakhon	2/500	-	-/-	-	-	9.80
9. Bo Win	2/500	10	2/500	-	-	20.21
10. Well Grow	4/750	-	-/-	-	-	20.00
11. Bangkapong	1/250, 1/500	-	-/-	-	-	7.00
12. Gateway	1/5 (TD), 1/250	-	-/-	-	-	20.00
13. Eastern	1/500	-	2/250	-	3/7.5	9.00
14. Bangpain	2/500	-	1/500	-	3/12	15.00
15. Hi-Tech	1/500, 3/500	-	1/500, 3/500	-	-	20.00
16. Saharatananakhon	NA	-	-/-	-	-	-
17. Nong Kae	4/500	-	1/500	-	4/12	16.90
18. Kaeng Khoi	4/500	-	2/300	-	4/12	20.00
19. Gemopolis	-	-	-	-	NA	-
20. Padaeng	NA	-	NA	-	NA	-

Table 4
Frequency and parameters of the environmental quality monitoring programme

N°	Type of environmental quality	Parameters	Frequency times per year
1	Air quality		2
	◆ Ambient air	Wind velocity and direction, TSP, NO_2, Pb, O_3, hydrocarbons	
	◆ Incinerator stack emission	TSP, NO_2, SO_2, CO	2
2	Water quality	pH, DO, salinity, turbidity, SS, TDS, TS, BOD, COD,	4
	◆ Surface water	NH_3-N, NO_3-N, Total-N, TKN, PO_4-P, total P, oil and grease, As, Cd, Cr, Fe, Hg, Pb, Zn, coliform, bacteria	
	◆ Gound water	pH, TDS, total hardness, COD, TKN, NO_3, Fe, Cl, coliform, bacteria	4
	◆ Sea water (chemical & biological)	pH, DO, transparency, salinity, turbidity, SS, TS, BOD, NH_3-N, NO_3-N, Total-N, PO_4-P, total P, oil and grease, phenol, Cd, Cr, Cu, Hg, Pb, Zn, fecal coloform, ecosystem (flora and fauna) i.e. primary product, plankton, benthos, larva	4
3	Silt	Particle size, TOC, BOD, oil & grease, As, Cd, Cr, Cu, Fe, Hg, Pb	4
4	Acoustic level	Leq, ldn	2

IEAT, nine of which are operated by IEAT with the remainder being joint venture projects. SGS (Thailand) Ltd. is the IEAT's contractor for monitoring the environmental quality of IEAT industrial estates, i.e. ambient air, incinerator stack emissions, noise level, groundwater, surface water, sea water and silt. **Table 4** shows sampling frequency and analytical parameters.

Developers of joint venture industrial estates are responsible for the environmental monitoring programme in regard to EIA. The analytical reports are sent to IEAT before forwarding to the Office of Environmental Policy and Planning, Ministry of Science, Technology and Environment.

Tables 5 and **6** show data from air pollution monitoring reports (sampling points A1-A5 in table 5 being to the south, east and west of the monitored zone). Reports are also produced for wastewater, solid wastes and site maintenance performance.

Table 5
Ambient air analytical report
Chonburi Industrial Estate

Sampling point	Particulate	SO_2	NO_2
1. A1	0.086	0.003	0.013
2. A2	0.145	0.002	0.020
3. A3	0.143	0.100	0.014
4. A4	0.086	0.002	0.005
5. A5	0.194	0.001	0.009
Standard	0.330	0.300	0.320

Table 6
Incineration stack emission analytical report.
Chonburi Industrial Estate Feb. 03 1996

Sampling point	Dimension (m)	Temp (°C)	Velocity (m/sec)	Air quantity (m^3/min)	TSP (mg/NM^3)	SO_2 (mg/NM^3)	NO_2 (mg/NM^3)
Stack	0.70	200	6.36	146.92	264.15	32.09	0.057

Monitoring facilities

Central laboratories

All industrial estates have a central laboratory to analyse air and water quality.

IEAT's mobile laboratory

In an emergency such as public complaints of nuisance, danger, or environmental impact of industrial operations in the industrial estates, IEAT's mobile laboratory will immediately move to sample and measure air quality.

Automated Environmental Monitoring System

IEAT has planned to set up automated monitoring stations to check the quality of the ambient air and central effluent of industrial estates. The telemeter system will record real time information and transmit it to IEAT's headquarters by means of transmission line. Hence it will enhance immediate response to any environmental problems.

The first monitoring station has been set up at Map Ta Phut Industrial Estate to check the quality of an outfall stream to the sea. The monitoring parameters are temperature, pH, DO, COD, SS, conductivity, turbidity and ultraviolet.

The first air quality monitoring station at Map Ta Phut I.E. will be completed by 1997 to monitor particulates (10 µm), CO, NO_2, SO_2, hydrocarbons, O_3, wind velocity and direction, humidity and air pressure.

In the 1997 fiscal year, two air and water quality monitoring stations will be set up at two industrial estates: Laem Chabang, and Bangpoo and Bangplee.

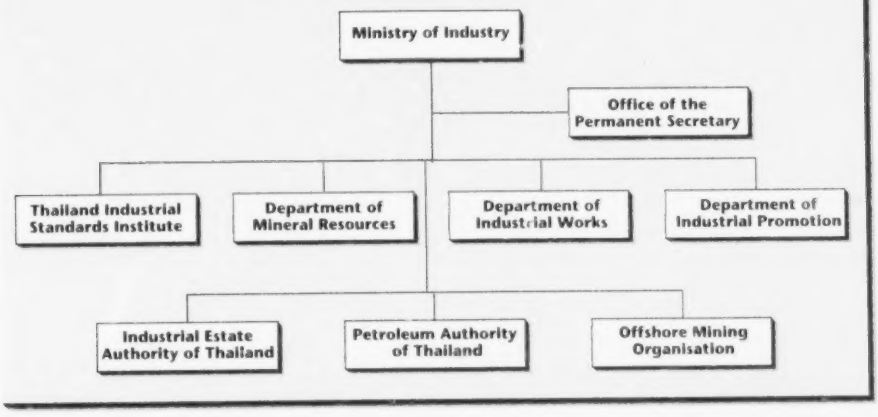
Environmental information centre

A Geographic Information System (GIS) is being established at IEAT's headquarters. The GIS will have on-line connection with all industrial estates to collect basic environmental information on, for example, wastewater, air emissions, solid and hazardous wastes, and the geographical distributions and positions of these wastes at each industrial estate. It will increase the efficiency of IEAT's environmental management system.

IEAT has thus taken various measures to monitor environmental quality at the industrial estates with speed and accuracy. ◆

Appendices on page 25

Appendix A
Organisation of Ministry of Industry


Ministry of Industry
Office of the Permanent Secretary
Thailand Industrial Standards Institute
Department of Mineral Resources
Department of Industrial Works
Department of Industrial Promotion
Industrial Estate Authority of Thailand
Petroleum Authority of Thailand
Offshore Mining Organisation

Appendix B-1
Acceptable characteristics for central wastewater treatment process

1.	Average BOD5	≤ 500 mg/l
2.	Average suspended solids	≤ 200 mg/l
3.	pH	5.0 - 9.0
4.	Temperature	≤ 45 °C
5.	Sulphides such as hydrogen sulphide	≤ 5 mg/l
6.	Cyanides such as hydrogen cyanide	≤ 2 mg/l
7.	Oil and grease	≤ 10 mg/l
8.	Tar	≤ 10 mg/l
9.	Formaldehyde	≤ 2 mg/l
10.	Phenol and cresols	≤ 1 mg/l
11.	Free chlorine	≤ 5 mg/l
12.	Insecticide	none
13.	Radioactive compound	none
14.	Fluoride (F)	≤ 5 mg/l
15.	Free ammonia	≤ 5 mg/l
16.	Total ammonia nitrogen as N	≤ 50 mg/l
17.	Mercury and mercury compound	≤ 0.005 mg/l
18.	Soluble iron and manganese	≤ 10 mg/l
19.	Chromium, arsenic, silver, selenium, lead, nickle, barium, copper, cadmium, total or each	≤ 1 mg/l
20.	Other materials that should not be discharged into the wastewater pipeline: • high viscosity material • settleable solids that cause pipe clogging • calcium carbide sludge	
21.	Synthetic detergent	≤ 30 mg/l
22.	Chloride (Cl) as chlorine	≤ 2,000 mg/l

Appendix B-2
Notification of Ministry of Science, Technology and Environment N° 3 (B.E. 2539)

Effluent Standard for Industrial and Industrial Estate Sources

1.	pH	5.5 - 9.0
2.	TDS	5,000 - 5,000 mg/l
3.	SS	50 - 150 mg/l
4.	Temperature	40 °C
5.	Colour and/or odour unobjectionable	
6.	Sulphide (H_2S)	1 mg/l
7.	Cyanide (HCN)	0.2 mg/l
8.	Heavy metals	
	8.1 Zn	5.0 mg/l
	8.2 CR^{6+}	0.25 mg/l
	8.3 CR^{3+}	0.75 mg/l
	8.4 Cu	2.0 mg/
	8.5 As	0.25 mg/l
	8.6 Hg	0.005 mg/l
	8.7 Cd	0.03 mg/l
	8.8 Ba	1.0 mg/l
	8.9 Se	0.02 mg/l
	8.10 Ni	1.0 mg/l
	8.11 Mn	5.0 mg/l
9.	Fat, oil and grease	5 -15 mg/l
10.	Formaldehyde	1 mg/l
11.	Phenols	1.0 mg/l
12.	Free chlorine	1.0 mg/l
13.	Pesticide	NA
14.	BOD	20 - 60 mg/l
15.	TKN	100 - 200 mg/l
16.	COD	120 - 400mg/l

Remark: The standard depends on the condition of receiving waters and type of industries, under consideration of the Pollution Control Committee.

Environmental management of industrial parks: case study of Pequiven's Jose Complex

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Abstract

Pequiven, a subsidiary of Petróleos de Venezuela, manufactures petrochemical products and sells them in domestic and international markets. It gives full support to enforcing worker safety and environmentally sound operating procedures that reduce risks to the environment and communities while complying with international and local legislation. This article presents the general programmes Pequiven has established for day-to-day safety and environmental management and recent experience with the environmental management of industrial parks.

Résumé

Pequiven, filiale de Petróleos de Venezuela, fabrique des produits pétrochimiques qu'elle vend sur les marchés nationaux et internationaux. Elle cautionne sans réserve l'adoption de mesures pour la sécurité des ouvriers et de procédures d'exploitation qui réduisent les risques posés à l'environnement et aux communautés tout en respectant la législation locale et internationale en vigueur. Cet article présente les programmes généraux que Pequiven a élaboré pour assurer la sécurité quotidienne de ses employés et la bonne gestion de l'environnement. En outre, il relate des expériences récentes en matière de gestion écologique des parcs industriels.

Resumen

Pequiven, una subsidiaria de Petróleos de Venezuela, fabrica productos petroquímicos y los vende en el mercado interno e internacional. Brinda un apoyo completo al refuerzo de la seguridad del trabajador y a procedimientos de funcionamiento que acústicamente respeten el mdioambiente, que reduzcan los riesgos para el medio ambiente y a las comunidades, al mismo tiempo que cumplen con la legislación internacional y local. Este artículo presenta los programas generales que Pequiven ha adoptado para la seguridad cotidiana y la gestión medioambiental y la experiencia reciente con la gestión medioambiental de parques industriales.

Introduction

Pequiven, a subsidiary of Petróleos de Venezuela, is a company that manufactures petrochemical products and sells them in both domestic and international markets. Its aim is to develop the Venezuelan petrochemical industry into a regional leader, based on the comparative advantages that the country enjoys, while fulfilling the needs of its customers and achieving the highest possible yield for the shareholder.

Pequiven directly employs 4200 workers. It operates three petrochemical complexes located at El Tablazo in the west of the country, Morón in the centre, and Jose in eastern Venezuela. The company also owns a BTX plant at the El Palito refinery and the Borburata Marine Terminal, both located close to Morón. It has two wholly owned subsidiaries, as well as direct interests in 17 joint ventures with both local and foreign partners.

Pequiven is organized in three business units which are responsible for the development of a wide range of over 40 products: olefins and plastics, fertilizers, and industrial products (aromatics and oxygenates).

For the near future, Pequiven is examining with prospective partners the feasibility of carrying out major new projects around the Anzoategui Petrochemical Complex at Jose. Eastern Venezuela is a region with considerable natural gas reserves. These projects envisage the construction of world-scale plants for the manufacture of olefins and fertilizers. They provide the launching base that will take Pequiven production from the current 7 million to 15 million metric tonnes per year by 2005, enabling it to consolidate its presence in international markets.

Pequiven is fully conscious that the achievement of its goals will depend on project execution being carried out in harmony with the environment and with the communities where it operates. It is therefore giving its full support to the implementation of this policy, enforcing worker safety and environmentally sound operational procedures that reduce risks to the environment and communities while complying with international and local legislation. The recognition that a growing awareness of the need for resource conservation among scientific, political and community sectors is placing new demands on the industry amply validates the need to set new trends in the environmental and safety management of our business.

Environmental and safety programmes at Pequiven

As we said before, Pequiven is fully committed to a long standing safety and environment policy. Known internally as the Corporate Integral Protection Policy, it addresses itself to the responsibility inherent in each worker to perform his job giving all his support to the accomplishment of the Safety and Environment Policy in a safe and environmentally sound manner, in order not only to protect his health and physical integrity but also to reduce risks to the environment and the community. The Policy also requires strict adherence to laws, regulations and standards, as set forth by the government or by the company.

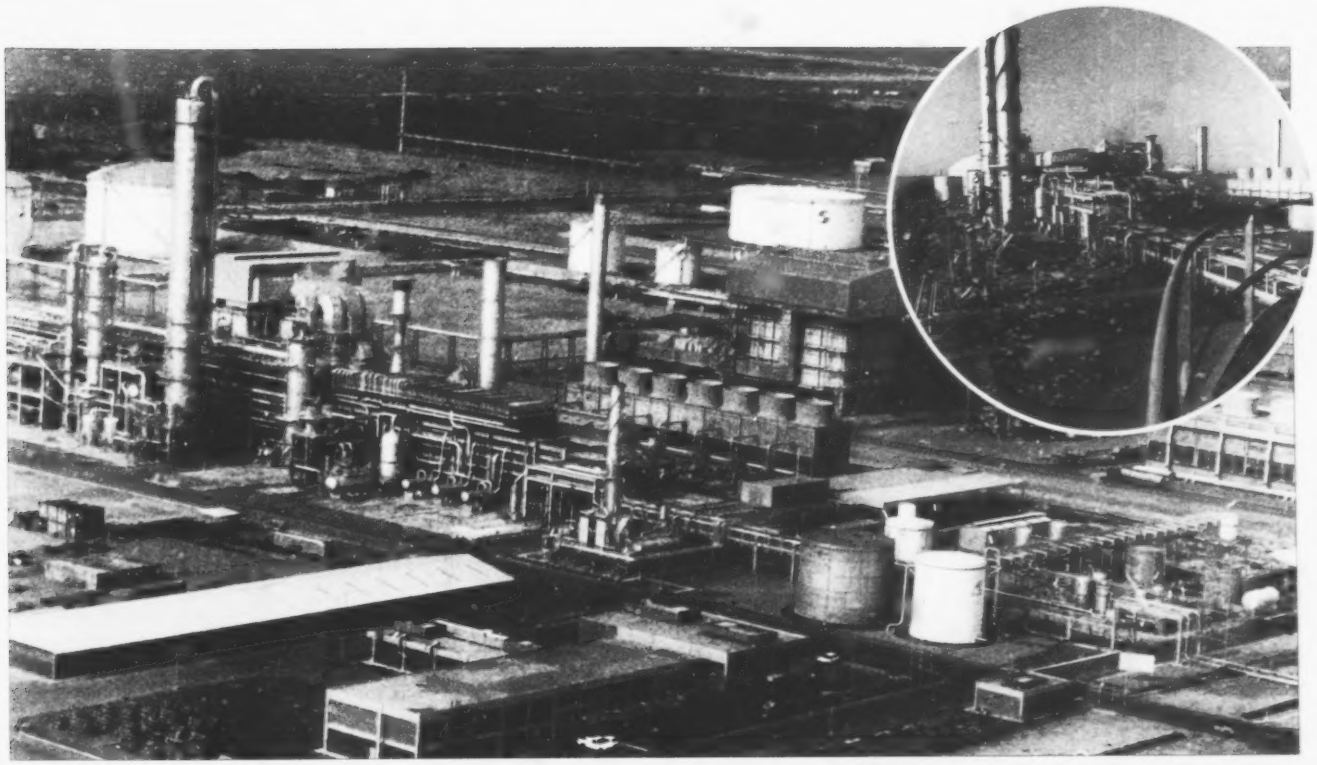
Over the years, the Policy has been the object of a continuous improvement process. In the company's early stages, from 1954 to 1975, it ran Safety and Industrial Hygiene Programmes reporting to the Human Resources Department. Later, in 1976, it also developed the Environmental Protection Programmes under the Technical Department. Finally, in 1984, Pequiven brought both activities under one roof by setting up the Corporate Integral Protection Department. We have, since then, been climbing the learning curve, updating our technical knowledge of all these issues and learning from our own experience. Since October 1992, we have also taken over the Venezuelan Responsible Care programme, sponsored by the Chemical and Petrochemical Industrial Association (ASOQUIM).

We will now focus on the general programmes we have established for day-to-day safety and environmental management:

Management: Safety and environmental aspects are integral parts of business activities. Therefore, adequate resources are provided. Every worker is responsible for good performance in Integral Protection activities.

Training and education: It is a priority to ensure that all workers at any Pequiven installation, including temporary employees and contractors, receive appropriate education and training on hazard identification and correct handling of tools and materials, together with emergency and job

Industrial estates



related procedures. This is made mandatory by law, with the employer held responsible for training and information on hazards.

Operating procedures: Written operating procedures and instructions are made available in order to satisfy the design intent of the installation and maintain its integrity. These procedures include instructions for handling abnormal conditions, emergency shutdown procedures, startup procedures, etc.

Hazard identification and quantification of risk: Critical examination techniques, such as hazard analysis, hazard and operability studies (HAZOP), and fault tree and event tree analysis, are applied in order to identify and rank critical hazards. These studies also make it possible to eliminate or reduce risks, providing guidance for decision making on preventive measures.

Maintenance programmes: Maintenance, inspection and testing of equipment are conducted on a regular basis to ensure that they continue to be appropriate in relation to safety and environmental requirements. The programme also includes record keeping on safe maintenance procedures and equipment reviews and reliability assurance procedures.

Management of change: Neither repair work nor modifications to plant equipment, processes, facilities or procedures can be done without a registered and assessed analysis, so that the necessary hazard studies are carried out, the appropriate design considerations are made, and the changes proposed are engineered and recorded.

Figure 1
Pequiven's Integral Protection Audit

Item	Some main aspects to be checked
Management involvement	Inspection tours Resources Enforcement
Operational procedures	Process description Startup procedures Emergency shutdown procedures Sampling procedures Operator training
Maintenance programmes	Equipment files Pressure vessels registered Pressure relief valves sized and registered Equipment installed to specifications Inspection frequency Equipment files
Management of change	Level of authorization Hazard analysis and risk evaluation Preventive measures taken
Plant layout and work area	Safe distances between equipment Safe distances to neighborhood Emergency exits Housekeeping Signs/instructions posted
Fire detection and control systems	Inspection frequency Calibration programmes Testing programmes
Environmental programme	Fugitive emission reduction and control Effluent quality Hazardous waste disposal Law and regulation compliance
Industrial hygiene and medical surveillance	Personal monitoring Respiratory protection programme Noise reduction and hearing conservation MSDS sheets for chemicals in process Ionizing and non-ionizing radiation Heat stress Medical protocols
Emergency planning	Emergency procedures Notification procedures Training programme Equipment available for emergency control

Industrial hygiene and medical surveillance: This programme focuses on the evaluation and control of physical, chemical, ergonomic and biological factors at the workplace. It also includes all medical examinations that contribute to worker health evaluation.

Safety, heath and environmental procedures: This programme includes all standards, such as work permit procedure, confined space permit procedure, accident investigation and record keeping, personal protective equipment procedures, air emissions standards, etc.

Emergency planning: On-site and off-site emergency plans are being reviewed regularly. All personnel involved in emergency response are being trained to assure their capability.

Auditing: Pequiven has recently developed a self-auditing procedure to evaluate the effectiveness of its programmes, compliance with the law, and the whole organization's performance in relation to the Integral Protection Policy. These audits not only enforce programme compliance, but also help identify needs for additional resources or further administrative measures. **Figure 1** shows some of the aspects to be checked.

Pequiven's Jose Complex: case study

Pequiven's Jose Complex is officially named "Complejo Petroquímico José Antonio Anzoátegui". Located at Jose, in the State of Anzoategui on the eastern

Industrial estates

Figure 2a
Pequiven Jose Complex environmental impact assesment
Some examples of impact characterization
Phase : construction

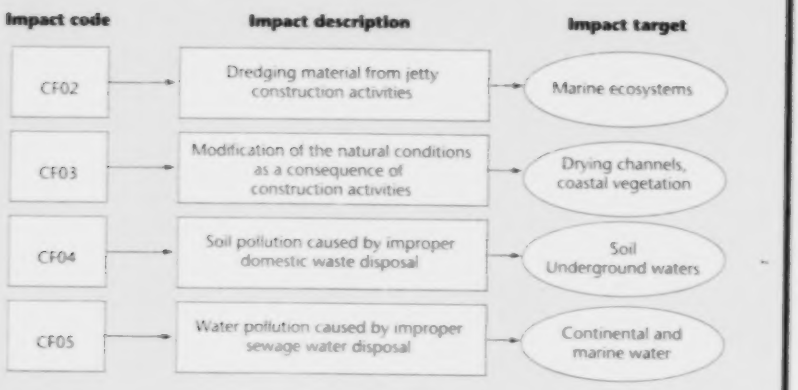


Figure 2b
Pequiven Jose Complex environmental impact assesment
Some examples of mitigation measures
Phase : construction

Related impact code	Measure description
CF02 CF05	Provision to develop further studies to evaluate the sensibility of the coastal marine ecosystems in order to prevent stress on them.
CF03	To restore the natural conditions in the north area of the Complex to help natural species (flora, fauna) to return to their habitat. It also includes a general clean-up.
CF04	Collection, transport and final disposal of domestic wastes. This measure include : recommendations on collection, frequency, waste classification and its transport and final disposal at the local landfill.
CF05	Collection, traetment and final disposal of sewage water during the construction of the Complex. It includes temporary controls (e.g. septic tanks) and recommends the early construction of the collection system and treatment plant.

Venezuelan coast, it covers 2177 hectares, of which Pequiven has so far developed only about 12 per cent.

The complex is designed to provide services and infrastructure facilities to prospective joint venture partners. It provides:

- fresh water, supplied from the Neveri river to the site via a 30-inch pipeline, with 600 litres per second pumping capacity;
- electricity, up to 120 MW, provided from the Raúl Leoni hydroelectric dam;
- fuel gas and natural gas, supplied by Pequiven on behalf of Corpoven, a Petróleos de Venezuela subsidiary;
- leases for administration offices;
- firefighting services;
- medical services;
- overall security and maintenance of perimeter roads.

At the moment, Pequiven's Jose Complex has one MTBE plant that came on stream in 1991 and two methanol plants that started up in 1994.

For the near future, Pequiven is examining the feasibility of new developments in the areas of fertilizers and olefins.

Without entering into in-depth analysis of the petrochemical processes at Jose, either present or future, it should be recognized that some raw materials and products may represent potential risks to health, environment and property. Consequently, we have adopted the use of hazard analysis and risk management methodologies.

As a first step, Pequiven conducted its first Environmental Impact Assessment (EIA) at Jose from July 1987 to August 1988, when neither national laws nor local regulations required it. This permitted the evaluation of potential impacts on the future industrial park and its surroundings. Original park design initially contemplated the construction of infrastructure and the MTBE plant. Despite original misgivings concerning some of the EIA findings, the technical team soon gave them unstinted support when it was seen that the new courses of action recommended actually produced net savings in construction costs. Since then, EIA is widely accepted as a valuable tool in new project development.

Some examples of the adverse impacts identified by EIA in the construction and operational phases at the original Jose Complex Project are shown in **Figures 2-a and 3-a**. The related mitigation measures recommended in order to minimize these impacts are shown in **Figures 2-b and 3-b**.

The final EIA report established 29 recommendations to minimize adverse impacts and to improve human environmental quality. The following provides a general recommendation summary:

- prevention and control of industrial pollution through the design of a general plan for the environment: this is continuously updated in accordance with technical and regulatory changes;
- provision of further risk evaluation and quantification studies to identify zones of impact or communities at risk: as soon as those studies were concluded, a safe zone around the complex was defined, thereby establishing restrictions on the encroachment of neighbouring housing;
- prevention of natural resources depletion;
- provision of clean drinking water and the establishment of a minimum level of sanitation;
- promotion of urban quality and the protection of historical and cultural sites.

EIA also provided the basis for drawing up guidelines for the safety and environmental management of the industrial park:

- The development of new projects – from the initial feasibility study stage to actual physical construction – will require that Environmental Impact Assessment (EIA) and other process analyses (Preliminary Hazard Assessment – PHA, Hazard and Operability Studies – HAZOP) conducted in order to identify potential risks at early stages.
- The use of Clean Technologies in all industrial processes to be installed at the park is shown as highly desirable; however, in those cases where the use of even the most advanced technology may still produce waste streams, joint ventures will have to be set up for the purpose of building and operating treatment units which satisfy environmental regulations.
- The operators of each plant to be installed are to be responsible for their own performance in all safety, health and environmental aspects. At present, all ventures currently in operation have developed programmes on waste minimization, air emissions control, safety processes, industrial hygiene, etc.
- Pequiven is to act as the principal coordinator of all activities within the complex in its role as the industrial services provider, as already mentioned. It will also, through our function, promote, coordinate and audit compliance with environmental, safety, and health regulations.
- When additional general studies on safety and the environment touching on overall operations are required, Pequiven will act as project coordinator, sharing out study costs among the joint ventures. Examples of current studies are the

Figure 3a
Pequiven Jose Complex Environmental Impact Assesment
Some examples of impact characterization
Phase : operation

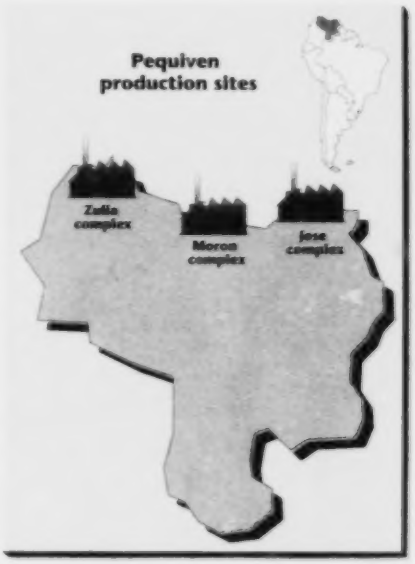
Impact code	Impact description	Impact target
0F01	Fugitive air emissions affecting the surroundings	Air quality, vegetation
0S14	Potential risk of fire and explosions	Property loss Environmental impact
0F04 0F05	Soil and water pollution caused by improper hazardous waste disposal	Marine coast, soil, underground waters
0S10	Noise generation	Workers' health Community comfort

Marine-Coastal Baseline Study, the Air Quality Follow-up Study, and the Safety and Fire Brigades Training Programme.

As you can see, Pequiven is determined to carry out the development of its operations under sound environmental management and has empowered our function with enough authority to ensure that that policy is carried out. We are convinced that what we have learnt, and continue to learn, from our company's expansion is of value to our country's industrial development. This had led us to work closely with national and local government, industry and communities, contributing our experience to the drawing up of laws and regulations in the belief that informed opinion provides a contribution to sustainable development, with better health and a safer environment for everyone, as well as promoting a common understanding of the need for industrial development and the importance of its contribution to society's welfare. ◆

Figure 3b
Pequiven Jose Complex Environmental Impact Assesment
Some examples of mitigation measures
Phase : operation

Related impact code	Measure description
0F01	Provision of process and operational controls to eliminate or reduce hydrocarbon emissions to the air.
0S14	Provision of safety process and operational controls to eliminate or reduce the risk of fires and explosions. The measure includes hazard and operability studies at early stages in a project or when a change takes place. Emergency planning is also required.
0F04 0F05	Collection, treatment and final disposal of hazardous wastes.
0S10	Develop a noise control and hearing conservation programmes.



Yuan Hong Industrial Park, China

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The strategically located Yuan Hong Industrial Park (YHIP) can be found just near the important coastal town of Fuqing, in the southeastern Chinese province of Fujian. In May 1992 the China State Council approved the 5000 hectare development. When completed, YHIP will be one of the largest integrated industrial residential and commercial development projects in China. In 1994 RIET was commissioned to advise on an environmental management strategy and zoning policy for YHIP. The park is managed and marketed by the Singapore-based company, Singapore Pacific Management Services (SPMS). The company was established by the lead investors, including the Indonesian Salim Group, JTC International, Singapore Technologies Industrial, United Industrial Corporation Ltd., Singapore Land Ltd. and United Overseas Land Limited.

The first five-year phase encompasses an area of 1000 hectares in the southeastern section of the site. The overall master plan defines 2000 hectares for industrial development, currently zoned for food production activities and others. Most of the industrial development so far has been in the food sector, together with a few electronics companies. 2180 hectares is zoned for residential development, 271 hectares for green space, and a further 80 hectares for sports and recreation. The site is situated along a narrow coastal strip adjacent to the important fish production area of Fuqing Bay to the south, with a mountain range forming the northern boundary. Much of the strip is reclaimed land from dredging and reclamation activities that were completed in the 1950s. Ample water of high quality is supplied to the site from two large mountain reservoirs (Dong Gau and Dong Chang) that are also used for hydroelectric power production. An on-site wastewater treatment plant with a design capacity of 270.00 tonnes/day has been planned and is due to be operational in 1998/99. It will deal with municipal as well as pre-treated industrial wastewater. Adjacent to the site, major port works are underway.

For generations the narrow strip has provided a livelihood for the population, with forestry, agriculture and fish farming industries. More than 60 Natural Reserve Areas have been designated in Fujian province, twelve of which are located in Fuqing, with two of significance to YHIP. These relate to the two important species of fish native to Fuqing Bay, the Shangle clam and the Pingtan Huo fish. Several tree species in the area are protected. However, the extensive industrialization of the eastern provinces of China, particularly Guandong, Jiangsu and Zhejiang, has resulted in heavy coastal pollution with inevitable consequences for fish stocks that have been in decline for some time.

With this background, and with limited industrialization to date, the authorities and SPMS are working closely together to ensure that the development of YHIP occurs while taking due account of environmental protection. Before infrastructure and investment commenced, the company commissioned a baseline environmental survey of the site to identify the key issues for development and any constraints to activities. The assessment was undertaken largely by Chinese specialists over a one-year period. An EIA was undertaken subsequently, and this is currently being reviewed by the Chinese Authorities. This was executed to guidelines prescribed by the Fujian Environmental Protection Bureau (FEPB). To date the company has been able to resist the commercial pressures to secure investment in the park as quickly as possible, and is working with the FEPB to ensure that industrial development will have minimal additional impact on the environment.

China is taking increasing care of the environment, and the authorities are anxious to ensure that new investment will meet the requirements of its

Standards for industrial pollutants (air pollutant, trade effluent and solid waste) GBJ4-73)

a) National emission standards for industrial air pollutants (13 pollutants)

Pollutants	Standard applicable to	Standard		
		Chimney height (m)	Discharge quantity (kg/hr)	Emission concentration (mg/m^3)
SO_2 (sulphur dioxide)	power plant	30	82	
		45	1719	
		60	310	
		80	650	
		100	1200	
		120	1700	
		150	2400	
	metallurgical industry	30	52	
		45	91	
		60	140	
		80	230	
		100	450	
		120	670	
	chemical industry	30	34	
		45	66	
		60	110	
		80	190	
		100	280	
CS_2 (carbon disulphur)	light industry	20	5.1	
		40	15	
		60	30	
		80	51	
		100	76	
		120	110	
H_2S (hydrogen sulphide)	light industry & chemical industry	20	1.3	
		40	3.8	
		60	7.6	
		80	13	
		100	19	
		120	27	
fluorine compounds (as F-)	chemical & metallurgical industries	30	1.8	
		50	4.1	
		120	24	
nitrogen oxides No_x (as NO_2)	chemical industry	20	12	
		40	37	
		60	86	
		80	160	
		100	230	
chlorine (Cl_2)	chemical & metallurgical industries	20	2.8	
		30	5.1	
	metallurgical industry	50	12	
		80	27	
		100	41	
hydrogen chloride (HCl)	chemical & metallurgical industries	20	1.4	
		30	2.5	
		50	5.9	
	metallurgical industry	80	14	
		100	20	
carbon monoxide (CO)	chemical & metallurgical industries	30	150	
		60	620	
		100	1700	
sulphuric acid mist	chemical industry	30–45	260	
		60–80	600	
lead (Pb)	metallurgical industry	100		34
		120		47
mercury	light industry	20		0.01
		30		0.02
beryllium compounds (as Be)		40–80		0.015
dust	power plant (coal-fired)	30	82	
		45	107	
		60	310	
		80	650	
		100	1200	
		120	1700	
		150	2400	
	industry boiler: iron & steel industry			200

substantial body of environmental legislation. Responsibility for the monitoring of environmental pollution on the estate rests with the FEPB, who have an office (termed a command post) near to the park and maintain an active dialogue with the management. The FEPB work to the National Environmental Standards, together with specific Provincial requirements, applicable to general industry categories, with numerous additional industry-specific requirements. Stricter levels of control are in force at YHIP than for general industrial areas, due principally to the sensitivity of the coastal waters. ***(Key national emissions standards and additional standards for YHIP accompany this article.)*** Heavily polluting industry has been ruled out, and an application to undertake ship breaking and salvage operations was refused recently. The focus is on promoting high-tech industries with a need for the available high-purity water, thereby taking advantage of the high water quality. Companies so far resident at the site include a flour processor, an eel canning factory, an instant noodle manufacturer, and a toy manufacturer. Polluting industries such as textiles and tanneries have been avoided.

Building on the success story of Singapore in securing economic growth at the same time as protecting the environment, SPMS, the management company, is promoting YHIP as a model site. It is demonstrating the first steps of environmental management, and its future prosperity is assured as multinationals (MNC's) recognize the value of such activities to their own businesses. Many of the MNC's evaluating YHIP as prospective tenants have blueprints for Environmental Management Systems (EMS) in their proposed factories upon relocation. Where the management of an industrial estate also implement an effective EMS, extra protection of company investment is afforded to tenants, reducing the number of variables that can impact upon the bottom line of both the estate operators and the firms that operate from there. RIET is increasingly being asked by developers in the region for advice on sustainable management and operations of industrial parks. Collectively, these industrial parks will house the majority of Asia's new industries in the next century.

tables continued page 32 ☞

Ambient air quality standards (general industrial areas) GB 3095-82 (Class III)

Pollutants	Averaging time	Concentration mg/m3
total suspended particles (pm < 100mm)	24 hrs anytime	0.50 1.50
PM_{10} (particles 10 microns or smaller)	24 hrs anytime	0.25 0.70
SO_2	Annual mean 24hrs anytime	0.10 0.25 0.70
No_x	24 hrs anytime	0.15 0.30
CO	24 hrs anytime	6.00 20.00
O_3	1 hr	0.20

Ambient air quality
Targeted to meet Standard GB 3095-82 (Class II)

Pollutants	Average time	Concentration mg/m^3
total suspended particles (pm<100 micrometer)	24 hrs anytime	0.30 1.00
pm_{10}	24 hrs anytime	0.15 0.50
SO_2	annual mean 24 hrs anytime	0.10 0.25 0.70
No_x	24 hrs anytime	4.00 10.00
CO	24 hrs anytime	4.00 10.00
O_3	1 hr	0.16

Noise pollution
YHIP targeted to follow Standard GB 3096-93

Type	Noise standard for urban area (dBA)	
	Daytime	Night-time
Hotel	50	40
Residential, educational institution	55	45
Residential, commercial & industry	60	50
Industry	65	55
Roadsides	70	55

b) Allowable limits for trade effluent discharge to controlled watercourse:

No.	Pollutants	Max. concentration (mg/L)
1	mercury and its inorganic compounds	0.05 (as Hg)
2	cadmium and its inorganic compounds	0.1 (as Cd)
3	chromium (hexavalent) compounds	0.5 (as Cr6+)
4	arsenic and its inorganic compounds	0.5 (as As)
5	lead and its inorganic compounds	1.0 (as Pb)

c) Allowable limits for trade effluent discharge to sewer/watercourse:

No.	Pollutants	Maximum allowable limit (mg/L)
1	pH	6–9
2	total suspended solids	500 mg/L
3	BOD (5 days at 20°C)	60 mg/L
4	COD	100 mg/L
5	sulphide (as sulphur)	1 mg/L
6	phenolic compounds (as phenol)	0.5 mg/L
7	cyanide (as CN-)	0.5 mg/L
8	organic phosphorus	0.5 mg/L
9	oil and grease	10 mg/L
10	copper and its compounds	1 mg/L (as Cn)
11	zinc and its compounds	5 mg/L (as Zn)
12	fluoride	10 mg/L (as F-)
13	nitrobenzene	5 mg/L

Wastewater GB 8978-88, (Class I)

Pollutants	Class I standard mg/L
pH	6–9
suspended solids	70
BOD	30
COD	100
oil and grease	10
phenol	0.5
cyanide	0.5
sulphide	1.0
fluoride	10
phosphate (as p)	0.5
formaldehyde	1.0
nitrobemene	1.0
Cu	0.5
Zn	2.0
Mn	2.0

YHIP planning, water standards

a) Environmental quality standards for surface water mg/L GB 3838-88

No.	Parameter	Class II standards	Class III standards
1	temperature (°C)	T variation < 1°C in summer < 2°C in water	
2	pH	6.5 – 8.5	
3	sulphate (as SO_4^{2-})	250	250
4	chloride (as Cl^-)	250	250
5	soluble iron	0.3	0.5
6	total Mn	0.1	0.1
7	total Cu	1.0	1.0
8	total Zn	1.0	1.0
9	nitrate (as N)	10	20
10	nitrate (as N)	0.1	0.15
11	NH_3	0.02	0.02
12	total ammonium nitrogen	0.5	1
13	total P (as P)	0.1	0.1
14	permanganate index	4	6
15	dissolved oxygen	6	5
16	COD_{cr}	< 15	15
17	BOD	3	4
18	fluoride (as F^-)	1.0	1.0
19	selenium (Se^{4+})	0.01	0.01
20	total arsenic (Hs)	0.05	0.05
21	total mercury (Hg)	0.00005	0.0001
22	total cadmium	0.005	0.005
23	Cr^{6+}	0.05	0.05
24	total lead	0.05	0.05
25	total cyanide	0.05	0.2
26	phenolic compounds	0.002	0.005
27	oil and grease	0.05	0.05
28	anionic surfactant	0.2	0.2
29	total coliform (number/L)	-	10,000
30	pyrene (mg/L)	0.0025	0.0025

b) Marine water quality standards GB 3097-82

Parameter	Class II standards
suspended solids	≤ 50 mg/L
pH	> 0.3 – 8.8
COD	< 4 mg/L
dissolved oxygen	≥ 4 mg/L
temperature (°C)	not higher than 4°C compared with local water
coliform	< 10,000/L
toxic substances	see below

Maximum concentration in sea water (mg/L)

Pollutant	Class II standard, mg/L
Hg	0.0010
CD	0.010
Pb	0.10
total Cr	0.50
As	0.10
Cu	0.10
Zn	1.00
Se	0.02
oil and grease	0.10
cyanide	0.10
phenols	0.010
organo-chlorinated pesticides	0.020
inorganic N	0.20
inorganic P	0.030

Prise en compte de l'environnement dans la planification, la gestion et l'exploitation de la zone industrielle portuaire de Dunkerque

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Abstract
This paper explains the means implemented in the Dunkirk area, at the heart of northern Europe to ensure that industrial development occurs in perfect harmony with environmental protection whilst safeguarding the area's population. Schemes and structures have been designed in order to define a sustainable development programme with the full cooperation of all interested local authorities and partners as well as the French government.

Résumé
Cet article présente les moyens qui ont été mis en oeuvre dans la région de Dunkerque, au coeur de l'Europe du Nord, pour s'assurer que le développement de l'industrie se fasse en toute compatibilité avec la protection de l'environnement et la sécurité des populations. Des schémas et des structures ont été créés pour faire en sorte qu'un développement durable soit défini en concertation avec l'ensemble des partenaires locaux concernés et l'Etat français.

Resumen
Este artículo presenta los medios que han sido utilizados en la región de Dunkerque, en el corazón de la Europa del Norte, para asegurarse de que el desarrollo de la industria es totalmente compatible con la protección del medio ambiente y la seguridad de las poblaciones. Se han creado esquemas y estructuras para definir un desarrollo duradero en concertación con el conjunto de los coparticipes locales interesados y el Estado francés.

Introduction

La zone portuaire de Dunkerque couvre un peu plus de 6.000 hectares, dont la moitié est encore disponible pour des implantations nouvelles, sur des espaces diversifiés. La gestion en a été confiée à un établissement public autonome mais sous contrôle de l'Etat : le Port Autonome de Dunkerque qui a pour mission de gérer les infrastructures portuaires et la zone industrielle.

Quelques repères : un important complexe sidérurgique avec plus de 5.000 emplois à l'est ; deux raffineries, une centrale nucléaire de 6.000 mégawatts (la plus importante d'Europe) à l'ouest ; une grosse unité de fabrication d'aluminium récemment implantée et un complexe pétrochimique.

Depuis peu, du fait en particulier de l'existence de zones industrielles (zones d'entreprises) qui donnaient droit à des avantages fiscaux particuliers, des industries d'autres secteurs, tels que la para-chimie ou l'agro-alimentaire, se sont implantées.

La présence de toutes ces entreprises apporte de nombreux avantages à la collectivité, mais elle nécessite de la part des pouvoirs publics de faire preuve de la plus grande vigilance pour s'assurer que le développement de la zone portuaire ne se fasse pas au détriment de la qualité de la vie, de l'environnement ou de la sécurité des populations. A noter au passage que, sur cette zone portuaire, 15 établissements sont considérés comme des installations présentant des risques majeurs.

Cette vigilance doit s'exercer à l'égard des implantations nouvelles, mais elle doit aussi porter sur les activités plus anciennes, implantées à une époque où l'environnement n'était pas la préoccupation première. Cela implique la définition de programmes de "mise à niveau" comprenant des délais parfois mal acceptés par les élus ou la population. Plus les réglementations deviennent sévères, plus l'héritage du passé est d'ailleurs difficile à admettre.

La France dispose d'une législation forte permettant d'assurer le contrôle des installations industrielles polluantes ou dangereuses. C'est la législation des "installations classées pour la protection de l'environnement" qui trouve son origine dans un décret pris par l'Empereur Napoléon, en 1810. Elle a bien entendu été modernisée depuis cette date et les textes actuels datent de 1976 et sont régulièrement mis à jour. Elle prévoit que les installations les plus importantes doivent obtenir, en plus du permis de construire délivré par le Maire, une autorisation délivrée par le représentant local de l'Etat (préfet). Cette autorisation fixe les prescriptions que devra respecter l'industriel pour prévenir les pollutions et précise les normes de rejets dans le milieu. Ces prescriptions sont établies par un service technique régional de l'Etat (la Direction Régionale de l'Industrie, de la Recherche et de l'Environnement – DRIRE), après une procédure qui comporte une large consultation des acteurs locaux au travers, notamment, d'une enquête publique. Pour obtenir cette autorisation, l'industriel doit réaliser une étude d'impact et une étude des dangers.

Essentiellement axé sur la sidérurgie et la construction navale il y a une vingtaine d'années, le tissu industriel de la région de Dunkerque a été depuis profondément modifié et s'est largement diversifié : il est probable que, dans un avenir proche, le paysage industriel de cette région connaisse encore de nombreuses évolutions. Dunkerque, troisième port de France par son trafic, doit en effet tirer les avantages des grands évènements qu'ont été l'ouverture des frontières de l'Union Européenne et la mise en service du Tunnel sous la Manche avec les infrastructures routières et ferroviaires (Train à Grande Vitesse) qui lui sont associées.

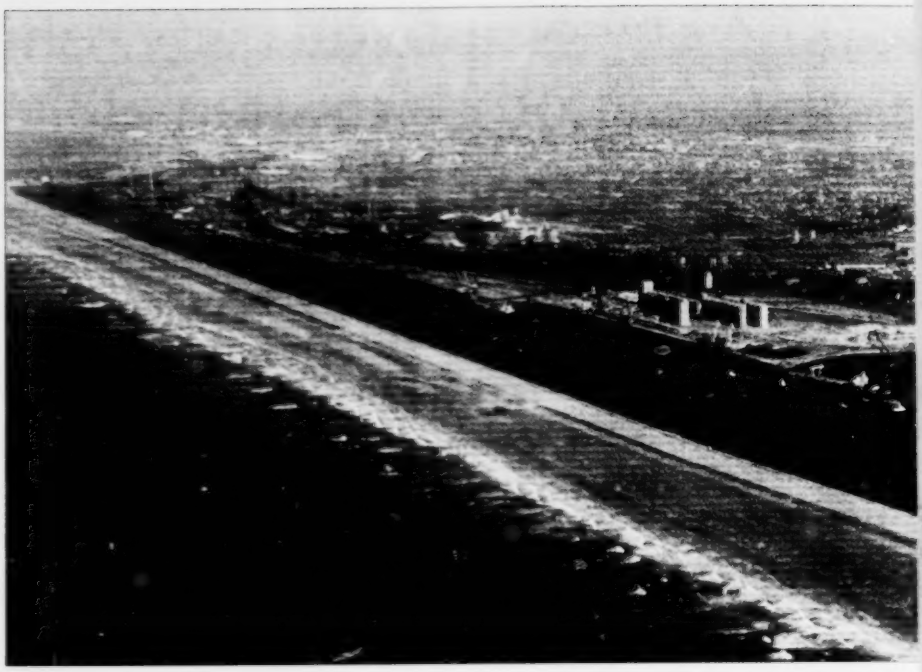
Une évolution des mentalités et des résultats appréciables

S'il subsiste sur le littoral du nord de la France des entreprises ayant le triste privilège de figurer parmi les plus gros pollueurs nationaux, cette situation ne doit cependant pas masquer les progrès importants accomplis ces dernières années et surtout les progrès que nous allons connaitre dans un avenir très proche. Ces progrès sont pour une bonne part le fruit de l'application de la réglementation efficace sur les installations classées pour la protection de l'environnement, qui a conduit à la mise en place, par les entreprises, d'investissements importants pour la sécurité et la lutte contre les pollutions : plus de trois milliards de francs en cinq ans sur le secteur de Calais-Dunkerque. Ces efforts n'ont pas été vains puisqu'on a pu, sur la même période, enregistrer une diminution de 50 pour cent des émissions de poussières dans l'atmosphère et des rejets de pollution organique et toxique dans les eaux, ainsi qu'une diminution de 30 pour cent des émissions de dioxyde de soufre (**Figures 1 et 2**).

Les entreprises ont pris conscience de la nécessité d'intégrer la sécurité et la protection de l'environnement à toutes les étapes de leur production et de leur gestion. Elle ont également compris qu'il fallait le faire savoir parce que, de plus en plus, l'environnement devient un élément de l'image de marque et même un atout contre la concurrence. Le dialogue entre l'entreprise et l'extérieur ne peut être que bénéfique. Il faut démystifier les usines et, surtout, éviter les préjugés ou la rumeur publique qui débouchent inévitablement sur un climat de suspicion et de méfiance qu'il est bien difficile d'inverser.

Même si les règlements sont scrupuleusement respectés, il n'est plus possible, de nos jours, de faire accepter a priori n'importe quel projet. Aucune industrie ne peut désormais survivre si l'on ne donne pas de réponse aux mécontentements ou aux inquiétudes qu'elle fait naître dans la population. Alors quelles structures faut-il mettre en place ? Quelle est la nature de l'information qu'il faut donner et comment la faire diffuser au plus grand nombre ?

Les réglementations, qu'elles soient nationales ou extra-nationales, sont certes des instruments indispensables, mais, aussi efficaces soient-elles, elles ne suffisent plus. La réglementation est, en quelque sorte, un garde-fou qui permet de fixer des règles du jeu minimales et de sanctionner ceux qui ne la respectent pas. Mais en matière de protection de l'environnement, comme dans beaucoup d'autres domaines, il faut autant que possible éviter la répression, qui est toujours un échec, et favoriser l'anticipation et la concertation. Il convient de changer les mentalités pour que chacun prenne pleinement conscience de l'ampleur réelle des problèmes et puisse mesurer tous les enjeux, qu'ils soient techniques, économiques, sociaux et, bien sûr environnementaux. Une solution semble être la création d'instances où l'ensemble des partenaires concernés puisse aborder sereinement ces questions, instances qui, en quelque sorte, constituent des relais à l'action publique classique.



Des instances de concertation

La zone industrielle de Dunkerque s'est dotée d'une panoplie d'outils de ce type ; le premier a été le réseau de surveillance de la qualité de l'air (AREMADEC). Le développement industriel, la présence de gros émetteurs de pollution atmosphérique, la pression des associations de défense de l'environnement, une volonté marquée des élus locaux et de l'Etat ainsi qu'une sensibilité croissante de la population à l'égard des problèmes d'environnement ont conduit à la création de ce réseau, il y a 20 ans, en 1976, ce qui d'ailleurs en faisait un précurseur en France. Il existe actuellement en France 33 réseaux similaires dans les zones fortement industrialisées ou fortement urbanisées.

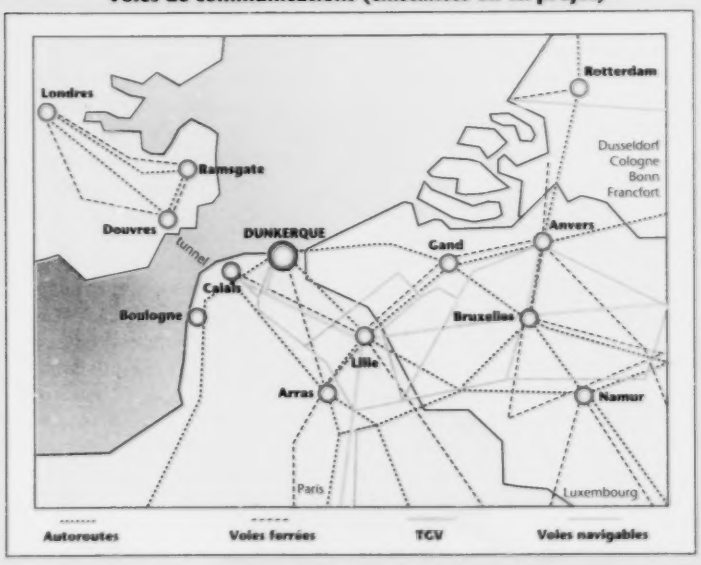
La nouvelle loi sur l'air, qui doit prochainement être adoptée, prévoit l'extension progressive de ces réseaux à l'ensemble du territoire français à l'horizon 2000.

L'AREMADEC est une association indépendante qui regroupe l'ensemble des divers partenaires locaux intéressés par les problèmes de pollution atmosphérique : collectivités locales et industriels de Calais et Dunkerque, Etat, associations de protection de l'environnement et scientifiques. Les objectifs de ce réseau sont la surveillance en continu de la qualité de l'air grâce à un ensemble de stations automatiques de mesures, l'information des partenaires associés, le suivi d'études et l'alerte en cas de pollution anormalement élevée.

Le financement du réseau est assuré pour une bonne part par les industriels locaux et les collectivités, mais aussi par l'Etat. L'AREMADEC dispose actuellement de 15 stations de mesure de la qualité de l'air (SO_2, poussières, O_3, H_2S, hydrocarbures, radioactivité,etc.) réparties entre Calais et Dunkerque.

Compte tenu, notamment, de l'efficacité reconnue du réseau de surveillance de la qualité de l'air, et dans l'optique d'instaurer une instance locale de concertation et d'information sur les autres domaines touchant à l'environnement industriel (eau, risques, déchets), une nouvelle structure a été mise en place il y a six ans, sur le littoral Calais-Dunkerque : le Secrétariat Permanent pour la Prévention des Pollutions Industrielles (SPPPI). Né de la volonté commune des élus, des industriels, des administrations et des associations pour la protection de l'environnement, de mieux intégrer l'industrie dans son environnement grâce

Dunkerque, une nouvelle position européenne
Voies de communications (existantes ou en projet)



à la concertation et à la transparence, le SPPPI du littoral Calais-Dunkerque a été mis en place en juillet 1990. C'est une assemblée collégiale locale réunissant l'ensemble des partenaires locaux ayant un intérêt pour les questions d'environnement industriel (chefs d'entreprises, élus, associations de défense de l'environnement, presse locale, services de l'Etat, experts,...).

Le SPPPI se compose d'un conseil qui décide des actions à mener et fixe les objectifs à atteindre et de cinq commissions techniques (Eau, Air, Déchets, Risques et Nouveaux Projets) qui sont chargées de mettre en application les décisions du conseil ; l'ensemble des partenaires sociaux locaux sont représentés dans ce conseil et dans les commissions techniques. Le Secrétariat Général du SPPPI est assuré par la Direction Régionale de l'Industrie, de la Recherche et de l'Environnement (DRIRE), service de l'Etat chargé, au niveau local, du contrôle des pollutions industrielles.

Il existe actuellement huit SPPPI en France, qui fonctionnent selon les mêmes principes d'ouverture et de transparence. Ces structures n'ont aucun rôle réglementaire et ne se substituent en aucun cas à l'action de l'Etat.

Le SPPPI a pour mission de favoriser, à l'échelon local, par la concertation et la transparence, les actions destinées à prévenir et à réduire les pollutions et les risques résultant des activités industrielles. Il oriente et lance des études sur les polluants et leurs effets, définit collégialement des objectifs et des mesures à prendre pour lutter contre les pollutions et minimiser les risques, notamment en coordonnant l'action des divers services et en assurant l'information du public, tant sur les problèmes liés à l'environnement que sur les moyens mis en oeuvre pour les résoudre. Le SPPPI dispose également d'un Centre de Documentation et d'Information du Public sur l'industrie et l'environnement.

Le fonctionnement du SPPPI est assuré grâce à des subventions allouées par les industriels, les collectivités locales et l'Etat (Ministère de l'Environnement et Ministère de l'Industrie), selon la règle des "trois tiers".

Concilier développement industriel et protection de l'environnement

L'objectif de développement industriel étant affirmé comme l'une des priorités essentielles de l'agglomération de Dunkerque, une démarche originale a conduit à l'élaboration d'un schéma d'aménagement et de développement industriels. Ce schéma vise notamment à intégrer les préoccupations d'environnement dans le développement et l'aménagement du tissu industriel grâce à la définition d'une stratégie de développement industriel s'appuyant sur les atouts du littoral Dunkerquois, des modalités d'insertion des projets industriels, des capacités d'accueil diversifiées pour toutes les typologies d'implantation industrielles, des conditions d'insertion dans l'environnement des projets industriels et la coordination des moyens financiers autour des objectifs de développement, d'aménagement et d'environnement industriel.

Cette démarche vise également à renforcer le partenariat des acteurs nationaux, régionaux mais surtout locaux, du développement économique : l'Etat, la Région, la Communauté Urbaine de Dunkerque, la Chambre de Commerce et d'Industrie de Dunkerque et le Port Autonome de Dunkerque. La volonté des partenaires est de valoriser les atouts dont dispose le site industriel portuaire. Ils ont défini deux conditions pour cela :

- rassembler les forces des uns et des autres dans un projet cohérent et concret qui permette d'optimiser les investissements et de clarifier l'offre foncière industrielle ;
- élaborer une politique d'aménagement industriel qui, réconciliant l'industrie et la ville, bâtisse l'avenir industriel sur des bases et sur des objectifs qui soient réellement partagés par tous, entreprises et habitants; ceci suppose une réelle démarche d'environnement industriel qui accompagnera celle engagée par ailleurs pour faire de Dunkerque un pôle de recherche et de transfert de technologie sur ce thème (création du Centre de Recherche sur l'Environnement Industriel de Dunkerque en 1992).

L'une et l'autre de ces démarches doivent contribuer à renouveler l'image du site industriel dunkerquois comme pôle de qualité pour l'implantation industrielle et son environnement. La mise en oeuvre du schéma répond ainsi, sur le champ des activités, à l'ensemble des actions de promotion du site urbain, de qualité de la vie et de développement, conduites parallèlement dans le cadre du Contrat d'Agglomération de Dunkerque.

Ce schéma, qui a rapidement pris le nom de schéma d'environnement industriel, constitue la première initiative du genre, en France et en Europe, pour faire en sorte que les collectivités locales et territoriales, les instances économiques, le monde associatif et les pouvoirs publics s'engagent dans une réflexion collégiale visant à concilier la prospective industrielle, la préservation de l'environnement et l'aménagement de l'espace. Cette opération a été confiée à l'Agence d'Urbanisme et de Développement de la Région Flandre-Dunkerque (AGUR).

Le schéma d'environnement industriel propose ainsi des règles d'implantation et d'aménagement au regard du respect de l'environnement et des populations. Il prévoit des principes d'aménagement, des dispositifs d'environnement industriel, des principes de traitement paysager, un schéma de dessertes et des moyens de mise en oeuvre. Ces règles, qui sont purement contractuelles, n'ont pas pour objet d'entraîner une surréglementation ou de se substituer à la réglementation déjà existante, mais constituent un cadre général local d'objectifs permettant d'assurer la transparence des processus de décision et de réduire ainsi les situations conflictuelles et également d'organiser un développement cohérent à long terme.

Tout nouveau projet industriel est présenté à la Commission "Nouveaux Projets" du SPPPI donc, par là même, à l'ensemble des partenaires locaux, avant le dépôt de la demande d'autorisation, et donc avant l'enquête publique. Cette Commission intervient lors d'implantations industrielles nouvelles ou d'extension d'installations existantes. Elle permet, en complément à la procédure normale d'instruction au titre de la législation en matière d'environnement industriel, de présenter les caractéristiques du projet, les efforts prévus pour réduire les pollutions, nuisances et risques, et d'assurer la cohérence de ce projet par rapport à la situation locale et au regard des objectifs fixés collégialement. Un autre intérêt est d'assurer très tôt l'information de tous les responsables locaux.

Le schéma industriel s'inscrit dans un cadre plus général voulant faire de la Région de Dunkerque un pôle d'excellence en matière d'environnement. Pour l'avenir, sur le littoral, un choix a été fait : celui de se donner les moyens d'intégrer à l'avance les préoccupations d'environnement dans le

développement, plutôt que de se précipiter sans se préoccuper de l'avenir et d'avoir à gérer plus tard des situations dégradées qu'il sera difficile de réparer.

Pour cela il faut que chacun y mette du sien et il faut surtout que tout cela se fasse dans la plus grande concertation et la plus grande transparence. Les outils mis en place semblent y contribuer largement et viennent compléter utilement l'action qu'exercent au quotidien les services de l'Etat chargés du contrôle des pollutions et risques industriels, en particulier les Directions Régionales de l'Industrie, de la Recherche et de l'Environnement (DRIRE).

Un exemple : la gestion des risques industriels dans la zone portuaire de Dunkerque

En France, une démarche cohérente a été entreprise pour mettre en place un dispositif efficace de gestion des risques qui s'articule autour de trois objectifs :

- réduire la probabilité des accidents, ou en limiter la gravité lorsqu'ils surviennent malgré tout, par la mise en application, dans les usines, de modalités d'exploitation appropriées, la mise en place de dispositifs techniques de sécurité, la sensibilisation et la formation du personnel, le respect des contraintes réglementaires ;
- accroitre l'efficacité et améliorer la qualité des secours par l'élaboration de plans de secours internes et de plans d'urgence externes ;
- limiter les conséquences d'un accident par des règles d'implantation des unités dangereuses, l'adaptation des plans d'aménagement urbains, le développement d'une information préventive auprès du public en vue de renforcer la protection des populations riveraines.

L'ensemble de cette politique de prévention des risques technologiques repose sur le principe déterministe qui consiste à affirmer que le "risque nul n'existe pas et que l'accident peut toujours se produire". Ce principe est justifié par les nombreux accidents de gravité variable qui surviennent chaque année en France et ailleurs dans le monde.

En matière d'aménagement de l'espace, les préoccupations sont de trois ordres : protéger les populations riveraines en veillant à les maintenir éloignées des usines dangereuses, permettre l'intervention rapide des moyens de secours et leur donner l'espace nécessaire à la manoeuvre, et garantir la pérennité de l'activité industrielle. Pour cela, il convient d'instaurer un contrôle des constructions au voisinage des entreprises à risques, c'est-à-dire prévoir des règles d'aménagement limitatives pour les autres installations industrielles (de façon à éviter les accidents en cascade : "effet domino"), pour les voies de circulation et pour les zones d'habitations urbaines.

L'Etat est chargé d'afficher les risques, c'est-à-dire de faire connaitre les caractéristiques des zones de danger et de proposer les contraintes d'urbanisme qu'il convient d'y faire appliquer. Ces zones sont déterminées en fonction des scénarios d'accident décrits dans l'étude des dangers ou les analyses de risque faites sous la responsabilité des exploitants et sous le contrôle de l'Etat. L'affichage des risques sert de base à la discussion avec les collectivités locales afin que les risques technologiques soient pris en compte dans les documents d'urbanisme. La législation française, grâce à une articulation entre les réglementations sur l'occupation des sols et les réglementations sur l'environnement industriel, a instauré un principe de réciprocité qui permet de garantir un éloignement suffisant entre installations à risques et constructions urbaines.

Le schéma d'environnement industriel mis en place à Dunkerque est allé au-delà de ces dispositions. Pour orienter l'implantation des industries comportant ou pouvant développer des technologies facteurs de risques, des "zones de vigilance" sont instituées. Celles-ci ont pour objet d'apporter des garanties aux populations et aux collectivités locales, mais aussi d'aider l'industriel dans le choix de son implantation.

Les zones de vigilance couvrent les zones industrielles situées à moins de 800 m des zones urbaines (et des zones d'extension urbaines figurant dans les Plans d'Occupation des Sols approuvés), ou des établissements recevant du public (sauf s'ils sont implantés à titre provisoire ou s'ils sont directement liés à l'exploitation économique du site). La création des zones de vigilance n'a pas de conséquences pour les installations industrielles préexistant à l'intérieur de celles-ci.

Ainsi, les implantations les plus proches des secteurs urbains privilégieront-elles les installations présentant les plus faibles niveaux de risque ; la transparence de l'information permettra à l'industriel d'anticiper sur les études de danger et l'évolution de son entreprise.

Ce dispositif oblige en retour, de la part des collectivités locales, le principe de réciprocité (non-extension des zones urbaines ou des installations recevant du public si elles ont pour conséquence l'extension des zones de vigilances).

La législation française a également réaffirmé le droit à l'information des citoyens sur les risques auxquels ils sont exposés et sur les mesures de sauvegarde prévues. L'efficacité des plans de secours et des plans d'urgence repose largement sur l'information préventive des populations avoisinantes. Il importe donc que les riverains des installations à risques connaissent mieux ces installations et les risques qu'elles présentent, sachent reconnaitre le signal d'une éventuelle alerte et connaissent les consignes à observer en cas d'accident.

Aussi est-il fait obligation de distribuer à l'ensemble de la population pouvant être concernée a priori par les plans d'urgence autour des industries à risques, des brochures d'information décrivant la nature des activités exercées, les risques des produits présents dans l'usine ainsi que la conduite à tenir en cas d'accident. Il importe que cette information soit renouvelée et pérennisée.

Une telle information a été donnée, en mai 1991 et en juin 1994, à chaque foyer des communes de la région de Dunkerque concernées par les risques induits par les établissements à haut risque ; plus de 100.000 brochures ont ainsi été distribuées à la population, aux écoles, aux salariés des entreprises, aux monde médical et para-médical... Des supports audiovisuels pédagogiques (film, cassette audio) à destination du grand public et des scolaires sur la prévention des risques, l'organisation des secours et la conduite à tenir en cas d'accident ont été élaborés et également distribués. Des actions de sensibilisation dans les écoles, auprès des associations et du milieu enseignant ont été et sont encore régulièrement menées. Un réseau de sirènes dont le but est d'alerter la population en cas d'accident industriel grave a été mis en place sur l'ensemble de la zone industrielle portuaire.

Conclusion

La grande mutation que connait le monde industriel implique des évolutions toutes aussi significatives de la Ville. Or, celle-ci est tributaire d'un certain nombre d'impératifs dûs aux contraintes d'environnement en particulier. Ces contraintes s'exercent à plusieurs niveaux. En effet, il n'est plus concevable d'exposer des populations à des nuisances ou à des risques incompatibles avec une qualité de vie acceptable. Les entreprises elles-mêmes sont de plus en plus exigeantes, pour des motifs d'image ou de standards de qualité dans les procédés de production. Enfin la collectivité publique -et notamment les collectivités locales- ne peuvent pas durablement faire face aux financements compensatoires dans le domaine de l'environnement dont on mesure de mieux en mieux l'ampleur. Il y a donc bien une spécificité d'aménagement de la ville industrielle à laquelle il convient d'apporter des réponses adéquates.

Cette spécificité se manifeste par un renforcement des réglementations en particulier à l'échelle européenne, au travers de dispositifs de protection ou d'information comme les Secrétariats Permanents pour la Prévention des Pollutions Industrielles (SPPPI), au travers d'efforts technologiques et d'innovation de la part des industriels et de la recherche.

Ces mesures sont pour l'essentiel curatives et à long terme ne permettent pas l'anticipation synonyme à la fois de cohésion, d'économie et de durabilité. C'est au niveau de la planification spatiale, de l'aménagement et de l'implantation des entreprises que s'exerce cette action en amont. Pour cela, il faut aborder les problèmes de cohérence d'aménagement au sein d'une même agglomération, maitriser les effets de la fiscalité, les facteurs de concurrence, de surenchères et d'incohérences entre territoires sur un même bassin d'activité, et enfin pouvoir rapprocher les impératifs de l'industrie et ceux de l'environnement, dans une perspective de mutation qui constitue le contexte du développement industriel.

Dunkerque est dans ce cas de figure. Aussi, en bâtissant son nouvel avenir industriel, la Ville a cherché à se doter d'outils de développement durable -le schéma d'environnement industriel et le Centre de Recherches sur l'Environnement Industriel (CREID)- ainsi que de structures permettant la poursuite d'une concertation permanente sur ces thèmes, telles que l'AREMADEC et le SPPPI, tous mis en place avec l'accord et l'appui de l'Etat français et de l'ensemble des partenaires locaux impliqués dans le développement économique et la protection de l'environnement. ◆

Desarrollo de las áreas industriales en el estado de Querétaro (México)

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Abstract
The strategic location of the land-locked State of Querétaro in Mexico provides it with advantages in terms of industrial production development not found in any other State. Up until the sixties Querétaro was a primarily agricultural state, since when its economy has been swiftly transformed in line with its rapid, dramatic industrialisation. It has now embarked on a programme to set up industrial estates in five of its 18 communes in the southern-most part of the State, with a view to extending its developed areas in order to try and inject some prosperity into its poorest regions.

Querétaro has set itself the task of incorporating environmental criteria within the framework provided by federal legislation and the first law on the environment ever promulgated by a Mexican State. The environmental criteria are intended to facilitate the transition between very strict legislation and a self-regulation model which provides for the involvement of the production sector.

This article looks at the history of the industrial development of Querétaro, covering the features specific to its industrial estates and parks and emphasizing the requirements which determine implementation of the environmental legislation stemming from both federal law and State law. Finally, it reviews the policies and criteria on which the Querétaro government is relying to clean up its industrial activities between now and the advent of the twenty-first century.

Résumé
Jouissant d'une situation géographique stratégique à l'intérieur du pays, et de particularités inégalables en matière de développement de la production industrielle, l'Etat du Querétaro, au Mexique, principalement agricole jusque dans les années soixante, a vu son économie se transformer rapidement et connu une industrialisation accélérée. Il entame actuellement la planification de zones industrielles sur le territoire de 5 des 18 communes que compte sa partie méridionale, planification qui doit être étendue de manière à rétablir l'équilibre avec ses régions les plus démunies.

Le Querétaro s'est fixé pour tâche d'incorporer au cadre fourni par la législation fédérale et à la première loi sur l'environnement jamais promulguée par un Etat mexicain des critères écologiques qui opéreront la transition entre une règlementation très détaillée et un modèle d'autorèglementation qui reflète la participation du secteur productif.

Cet article retrace le développement industriel de cet Etat. Il présente les caractéristiques de ses zones et parcs industriels en insistant sur les conditions déterminant la mise en oeuvre de la règlementation pour l'environnement d'origine fédérale d'une part, et étatique d'autre part. Enfin, il passe en revue les politiques et critères sur lesquels le gouvernement du Querétaro s'appuie afin que son secteur industriel produise plus propre d'ici à l'aube du 21ème siècle.

Resumen
El Estado de Querétaro en México, ha experimentado una rápida transformación de su economía básicamente rural en los años 60's, a una industrialización acelerada, como consecuencia de su ubicación estratégica al interior del país y de sus inmejorables características para el desarrollo productivo. En la actualidad, emprende un proceso de planificación de áreas industriales comprendidas en 5 de sus 18 municipios, en el sur del Estado, con perspectivas de ir logrando una proyección equilibrada hacia otras regiones mas necesitadas de su territorio.

Con base en el marco normativo federal y en lo que constituyó la primera ley ecológica estatal en el país, se ha dado a la tarea de incorporar criterios vinculados al medio ambiente que van transitando de un marco regulatorio muy puntual, hacia un modelo de autoregulación, en la que se refleje la participación activa del sector productivo.

En este artículo se hace referencia cronológica al desarrollo industrial de este Estado. Se describen las características de los parques y areas industriales con que cuenta, haciendo énfasis en las condicionantes para el cumplimiento de la regulación ambiental federal y estatal. Finalmente, se establecen las políticas y criterios del gobierno estatal que orientan los propósitos de contar con una planta industrial limpia en los albores del siglo 21.

1. Querétaro y su desarrollo industrial

Querétaro es un Estado de la República Mexicana en el que la historia, la cultura y el desarrollo confluyen, con un crecimiento importante a partir de la década de los 70's.

Se localiza en la parte central del país y está comprendido entre los paralelos 20° 01' 02" y 21°37'17" de latitud Norte y los meridianos 99°03'23" y 100°34'01" de longitud Oeste. A 210 km. de la Ciudad de México. Tiene una superficie de 11,769 km2 y una población de 1 051 235 hab. distribuida principalmente en los municipios de la parte Sur del Estado.

Debido a su ubicación estratégica se ha desarrollado una importante infraestructura industrial, puesto que es el punto de confluencia de las principales vías de comunicación que unen el occidente y norte del país con la ciudad de México. (**Figura 1**)

El sector industrial se ha configurado como la principal fuente de empleos en la entidad, por lo que es considerado el motor fundamental del crecimiento económico, ya que en la actualidad este sector ocupa el 40% de la Población Económicamente Activa del Estado, con el consecuente impacto en el producto interno bruto generado por el sector secundario. En 1970 su participación en el PIB estatal fue de 33.6% y en 1990 aumentó hasta un 52%, lo que a su vez repercutió en el PIB nacional que en 1970 fue de 0.30% y en 1990 aumentó a 1.25% lo que coloca a Querétaro en el 4o. lugar en industrialización a nivel nacional.

El desarrollo industrial del Estado de Querétaro inicia a mediados del siglo XIX con la instalación de una fábrica textil; en la década de los 40's se crea la primera zona industrial al noroeste de la capital de Querétaro y es en los años 60's cuando se empiezan a instalar empresas de alimentos, productos metálicos y autopartes a lo largo de la carretera Querétaro-San Luis Potosí. En esta época se establece la zona industrial "Parques Industriales" al oriente de la ciudad de Querétaro, con lo que empieza a cambiar la estructura económica que hasta ese momento era preponderantemente agropecuaria y en menor escala minera.

Las políticas de descentralización industrial que implanta el Gobierno Federal en los 70's dan mayor impulso al proceso de industrialización en el Estado. Por lo que en 1972 el Gobierno Estatal constituye el primer Parque Industrial "Benito Juárez". En ésta misma década se crean además los parques industriales : La Noria, La Cruz, San Juan

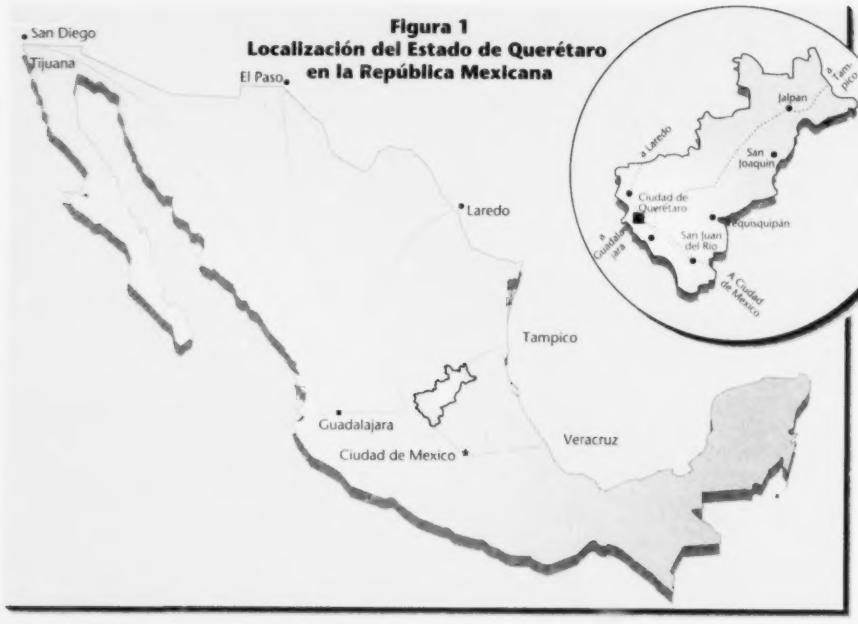


Figura 1
Localización del Estado de Querétaro en la República Mexicana

del Río, promovidos y administrados por Gobierno del Estado y por la iniciativa privada (**Figura 3**).

El creciente desarrollo industrial que registraba la Entidad en los años 80's motivó el establecimiento de nuevos parques y fraccionamientos industriales tales como: Jurica, San Pedrito, Balvanera, Bernardo Quintana y el Valle de Oro. A fines de ésta década se empieza a aplicar una cierta selectividad en los procesos de asentamiento industrial, considerándose aspectos urbanos y ambientales, de tal manera que cualquier nuevo asentamiento debia cumplir con las normas federales y estatales en materia de prevención y protección ambiental.

A partir de 1990 se están desarrollando los parques y fraccionamientos industriales Finsa, El Tepeyac, La Griega, Buenavista, La Peña, Mesa de León y el Parque Tecnológico Sanfandila los que desde su etapa de planeación han considerado los aspectos ambientales, sometiéndose al proceso de evaluación de impacto ambiental ya que marcan una pauta de apertura comercial en la diversificación de mercados en la competencia internacional y en la globalización de la economía, así como en la incorporación de criterios ambientales en la construcción y operación de los mismos para alcanzar un desarrollo sostenible.

Figura 2
Crecimiento de la actividad industrial en el Estado de Querétaro

A través de los años ha aumentado el número de industrias que se han establecido en el Estado como se puede observar en la **Figura 2**, que muestra la evolución que ha tenido este sector.

2. El corredor industrial Querétaro-San Juan del Río.

La concentración industrial se ha desarrollado principalmente en los municipios que por su posición geográfica forman parte del eje vial que comunica a la Zona Metropolitana de la ciudad de México con las regiones occidentales y norte del país (autopista México-Querétaro con una afluencia vehicular promedio de 50,000 vehículos diarios). Estos municipios son Corregidora, Querétaro, El Marqués, Pedro Escobedo y San Juan del Río, los cuales constituyen el Corredor Industrial del Estado como se muestra en la Figura 3, lo que representa el 89.72% del total estatal de establecimientos industriales ; por la diversificación industrial y la ubicación del Estado, éste adquiere una importancia relevante en el corredor industrial del Bajío que esta conformado por los estados de Jalisco, Guanajuato, Zacatecas, Aguascalientes, Michoacán, San Luis Potosí y Querétaro.

En el Estado existen aproximadamente 2,070 establecimientos industriales, de las cuales 1,227 se pueden considerar como las más representativas. Las principales actividades industriales que se desarrollan en el Estado son: alimentos y bebidas ; química y plásticos; textil ; papel e imprenta; eléctrica y electrónica y la de productos metálicos y autopartes ; siendo ésta última la predominante como se muestra en la **Figura 4**. En la **Figura 5** se observa que el tamaño de industria que predomina en el Estado es la microindustria.

3. Características generales de las áreas industriales

Actualmente se encuentran en operación 10 parques y fraccionamientos industriales, los cuales cuentan con infraestructura y equipamiento para albergar la actividad industrial. Se han instalado industrias de diferentes tamaños y giros industriales en cada uno de ellos.

Los parques que cuentan con mayor concentración industrial son el Benito Juárez y Jurica, y están ocupados en su totalidad. Cabe destacar que los otros parques cuentan con superficie disponible para el establecimiento de nuevas industrias. Cada uno de ellos se presentan en la **Tabla 1**. Además se cuentan con 8 zonas industriales en las que se han instalado empresas de diversos tamaños y giros, (**Tabla 2**).

El Gobierno del Estado impulsa una política de equilibrio entre la atracción de capitales productivos, generación de empleo, uso de tecnología moderna, capacitación eficiente y constante y la preservación del medio ambiente.

En el Plan de Desarrollo Integral del Estado (1991-1997), se establece que la promoción y crecimiento industrial debe dirigirse hacia el interior del territorio, teniéndose como propósito fundamental el de descentralizar el futuro crecimiento de las actividades industriales, concentrándolas a su vez en un número reducido de nuevos polos de desarrollo, para aprovechar las economías de aglomeración y optimizar los recursos necesarios de infraestructura. Se ha respondido en forma puntual al esfuerzo nacional de globalización, lo que ha generado un proceso de reconversión que se viene traduciendo en mayor productividad y calidad como factor

Tabla 1
Parques y fraccionamientos industriales en operación en el Estado de Querétaro

	Parque Industrial S.J.R.	Parque Industrial Bernardo Quintana	Parque Industrial Benito Juárez	Parque Industrial Jurica	Fracc. Agroind. La Cruz	Fracc. Industrial Balvanera	Fracc. Industrial San Pedrito	Fracc. Industrial Valle de Oro	Fracc. Industrial La Noria	Fracc. Industrial Finsa
Total industrias	28	35	95	65	13	33	12	28	3	2
Actividad industrial	Química Productos metálicos	Autopartes Química	Productos metálicos y autopartes Química y plásticos	Productos metálicos Química Alimentos	Productos metálicos Minerales no metálicos	Productos metálicos Química	Productos metálicos y autopartes	Química Papel Textil		Autopartes
Tamaño de industrias	Pequeña-Grande	Micro-Grande	Micro-Grande	Micro-Grande	Micro-Grande	Micro-Grande	Micro-Grande	Micro-Grande	Mediana Grande	Grande

común de las empresas.

Al contemplar la aplicación de la normatividad ambiental en la actividad industrial, se cumple con el propósito de garantizar la preservación de la calidad de vida de la población.

4. Hacia unos parques industriales limpios

Las directrices actuales del desarrollo industrial apuntan hacia la consolidación de los parques industriales existentes para ir cubriendo todos los requisitos nacionales e internacionales y obtener sus banderas verdes.

De igual manera los nuevos parques que se están creando, comienzan a cumplir con los lineamientos ecológicos y ambientales que establecen las leyes federales y estatales, desde su fase de planeación.

Aunado a estas políticas existe dos procesos paralelos: uno de reubicación de las industrias más problemáticas que se encuentran en las zonas urbanas y otro de selección de industrias que pretenden instalarse en el Estado considerando su consumo de agua; emisiones atmosféricas y generación de residuos peligrosos.

Como se ha señalado en los parques y zonas industriales el asentamiento industrial se dió como un proceso del crecimiento económico cuyos ejes principales fueron la producción de bienes destinados esencialmente al mercado interno y la generación de empleos, que en principio debían ocupar mano de obra local y que en realidad generaron polos de atracción para la mano de obra especializada, motivando que San Juan del Río y Querétaro tuvieran un crecimiento demográfico que superaba en más del doble a la media nacional.

El control de la contaminación ambiental en Mexico, como en muchos países se inicia en los años 70's con la aparición de la primera Ley Federal para Prevención y Control de la Contaminación y sus reglamentos en materia de agua; humos y polvos, y ruido, con lo que la industria empiezó a ser requerida para que disminuyera sus emisiones contaminantes.

La creciente necesidad de un control ambiental más comprensivo e integral dió origen a la expedición de la Ley General del Equilibrio Ecológico y la Protección al Ambiente en 1988, abrogando la Ley Federal de Protección al Ambiente de 1982, expidiéndose además sus reglamentos en materia de impacto ambiental; de residuos peligrosos; y de prevención y control de la atmósfera, apoyándose con la expedición de Normas Técnicas Ecológicas, que en los 90's cambiaron a Normas Oficiales Mexicanas y a las cuales deben sujetarse las empresas (**Tabla 3**).

Con la Ley General del 88 la Federación da un paso trascendental al otorgar a los Estados la facultad de legislar en materia de equilibrio ecológico y protección al ambiente. Querétaro es la primera entidad en emitir su Ley Estatal del Equilibrio Ecológico y la Protección al Ambiente en mayo de 1988, y a partir de los 90´s participa con mayor intensidad en la prevención y control de la contaminación industrial y en la planeación y control de los asentamientos industriales, coordinando sus acciones con el gobierno federal y los gobiernos municipales.

Figura 3
Corredor industrial del Estado de Querétaro y sus áreas industriales

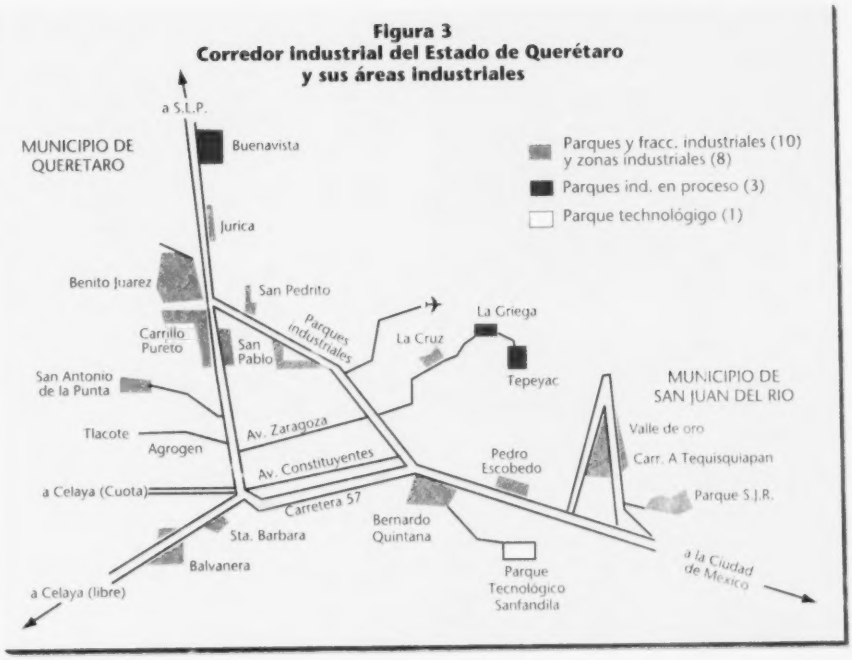


Tabla 2
Zonas industriales

	Carr. a Tequisq.	Pedro Escobedo	Parques industriales	Av. 5 de Febrero	Carillo Puerto	San Pablo	San Antonio de la punta	Santa Barbara
Total de industrias	20	17	9	18	25	16	7	2
Actividad industrial	Papel y editorial Química	Química Productos metálicos Alimentos	Productos metálicos Química	Alimentos Productos metálicos	Productos metálicos Minerales no metálicos Química	Productos metálicos Alimentos	Alimentos Química	Productos metálicos Alimentos
Tamaño de industrias	Micro-Grande	Micro-Grande	Pequeña-Grande	Mediana Grande	Micro-Grande	Micro-Grande	Micro-Grande	Micro-Grande

Como consecuencia, se expide en 1989 una Ley Estatal de Desarrollo Industrial, que incorpora los criterios ambientales tanto para la promoción de áreas industriales como para el establecimiento de cada una en lo particular.

En el marco de la coordinación institucional la normatividad ambiental se aplica y se verifica su cumplimiento a través de diversas dependencias y organismos federales, estatales y municipales, en el ámbito federal es la Procuraduría Federal de Protección al Ambiente, organismo desconcentrado de la Secretaría de Medio Ambiente, Recursos Naturales y Pesca (SEMARNAP), quien ejerce estas funciones en 520 empresas de jurisdicción federal asentadas en el Estado, de estas el 50% generan residuos peligrosos; 16 % son de alto riesgo; y 18% de mediano riesgo; en el último año en su programa normal de visitas que cubrió alrededor de 250 empresas se detectó que el 79% tenían pequeñas irregularidades técnicas o administrativas y al 21% cumplieron al 100% con la normatividad. Cabe señalar que de las 520 industrias, aproximadamente el 95% se encuentran en parqués, fraccionamientos y zonas industriales.

Actualmente la PROFEPA promueve un programa voluntario de auditorias ambientales dirigido a empresas de alto riesgo y a las exportadoras de bienes.

El Instituto Nacional de Ecología, dependencia de la SEMARNAP, realiza labores técnico administrativas y de apoyo a las empresas de competencia federal a través de la expedición de licencias y autorregulaciones y registros en materia de impacto ambiental, emisiones a la atmósfera y registros de residuos peligrosos.

El vertido de aguas residuales de proceso o sanitarias a cuerpos receptores de jurisdicción federal es controlado por la Comisión Nacional del Agua (CNA), en cumplimiento a lo que establece la Ley de Aguas Nacionales, su Reglamento y las Normas Oficiales Mexicanas.

El desarrollo industrial es controlado por el gobierno estatal a través de una Ventanilla Unica, atendida por la Secretaría de Desarrollo Económico y apoyada por la Secretaría de Desarrollo Urbano, Obras Públicas y Ecología y la Comisión Estatal de Aguas, que revisan aspectos de promoción y apoyo; asentamiento industrial, impacto ambiental, riesgo, emisiones a la atmósfera, residuos no peligrosos; y descarga de aguas residuales a los sistemas de alcantarillado (**Tabla 4**).

Figura 4
Establicimientos industriales por actividad industrial

5. Perspectivas de la relación ambiente-industria

En 1996 se realizó en Querétaro un proyecto piloto nacional para establecer el Registro de Emisiones y Transferencia de Contaminantes (RETC), en el que participaron 80 empresas de diversos giros. El proyecto contó con el apoyo del Instituto de las Naciones Unidas para la Formacion Profesional e Investigaciones (UNITAR), participando el INE-SEMARNAP, Gobierno del Estado de Querétaro y la Cámara de la Industria de la Tranformación (CANACINTRA), con resultados alentadores que permiten prever su futura aplicación oficial en todo el país.

Por otra parte, como respuesta a los procesos de globalización de la economía y a los requisitos ambientales que en la producción de bienes están imponiendo las países avanzados, la industria de Querétaro, sobre todo la que se orienta a la exportación, está involucrada en un proceso de autorregulación a través de la certificación ISO-9000, ISO-14000 y QS-9000.

A nivel nacional y consecuentemente en el Estado de Querétaro, se prevé el fortalecimiento de la política ambiental en todos los órdenes, pero con cierto interés prioritario en el sector secundario de la economía representado por la industria en su conjunto.

El Programa de Medio Ambiente 1995-2000 constituye la base del desempeño programático de la gestión ambiental nacional, que define en acciones específicas la política ambiental para un crecimiento sustentable expresada en el Plan Nacional de Desarrollo 1995-2000.

El desarrollo industrial habrá de contemplar instrumentos de la política ambiental tales como el ordenamiento ecológico, la evaluación del impacto ambiental; los estudios de riesgo; regulación directa de materiales y residuos peligrosos y riesgosos; regulación directa de actividades industriales; auditoria ambiental y autorregulación, apoyados en una moderna reglamentación y normatividad.

Querétaro seguirá avanzando en un esquema de parques, fraccionamiento y zonas industriales, con un control más preciso sobre la situación ambiental de la industria; de la generación de residuos sólidos peligrosos y no peligrosos y de su disposición final; de las emisiones a la atmósfera y de las causas y transferencia de contaminantes. De manera particular buscará el ahorro energético integral de las empresas.

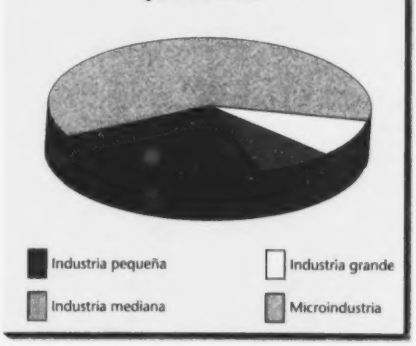
Se han dado los primeros pasos del desarrollo de parques microindustriales para facilitar la ubicación o reubicación y la integración de este sector mayoritario, facilitando al cumplimiento de la normatividad ambiental al disminuirse costos en la adquisición de equipos y tecnologías por grupo y fortaleciendo las cadenas productivas.

En el Estado de Querétaro se ha puesto especial interés en que haya una coordinación entre todos los sectores de la Entidad (público, social y privado) debido a que existe la preocupación y el deseo de crear las condiciones óptimas para que la industria y el medio ambiente se integren y logren un desarrollo sostenible, mediante el conocimiento y aplicación de todos aquéllos mecanismos, políticas, normas ambientales, tratados, convenios, la modernización industrial con tecnología limpia y el impulso de las ventajas competitivas industriales a nivel internacional dentro de la globalización comercial.

6. Consideraciones finales

Para consolidar el concepto de desarrollo sostenible en la entidad y sobre todo en el aspecto industrial, hay un interés manifiesto por adherirse a los 16 principios de "La Carta de las empresas para un desarrollo sostenido" que se basa en la Agenda 21 Capítulo 30 "Fortalecimiento del Papel del Comercio y la Industria". Con esta Carta se insta a las industrias a satisfacer las necesidades actuales pero sin comprometer la capacidad de las futuras generaciones.

Figura 5
Establicimientos industriales por tamaño



Las empresas deben ser, suficientemente flexibles, dinámicas, inventivas y rentables para engendrar un desarrollo económico sostenido y proporcionar tanto las capacidades de gestión como los recursos técnicos y financieros indispensables para solucionar los problemas ecológicos. Estos principios contemplan aspectos educativos, culturales, productivos, económicos y sociales que mantienen el equilibrio entre la industria y el medio ambiente.

Con todo ello Querétaro pretende ser una entidad más comprometida en la atención y solución de sus problemas ambientales, asociados al desarrollo industrial, cuya gestión se inscribe en el horizonte de un desarrollo integral con criterios de sustentabilidad para garantizar el bienestar de la población y la protección y conservación de su patrimonio natural.

Tabla 3
Instrumentos federales para la regulación de la actividad industrial en el Estado de Querétaro

Instrumento Jurídico	Descripción	Referencia
Ley General del Equilibrio Ecológico y la Protección al Ambiente	Establece las bases para el aprovechamiento racional de los elementos naturales	Art. 1
	Son asuntos de interés de la Federación la regulación de las actividades altamente riesgosas	Art. 5
	Regula las actividades de ordenamiento ecológico del territorio que tienen implicación para la industria	Art. 3,19,20
	Faculta a la SEMARNAP para expedir las Normas Oficiales Mexicanas	Art. 108, 109
Reglamento de la LGEEPA en Materia de Impacto Ambiental	Establece los mecanismos y procedimientos para la aplicación de la política general ecológica para la evaluación del impacto ambiental de actividades industriales	Todos los artículos
Reglamento de la LGEEPA en Materia de Residuos Peligrosos	Regula las actividades de generación, almacenamiento, transporte, reciclaje y disposición final de residuos peligrosos.	Todos los artículos
Reglamento de la LGEEPA en Materia de Prevención y Control de la Contaminación Atmosférica	Regula la actividad de generación de emisiones de contaminación atmosférica.	Todos los artículos
Reglamento de la LGEEPA en Materia de Prevención y Control al Agua	Establece los mecanismos y procedimientos para la prevención y control de la contaminación de aguas residuales	Todos los artículos
Reglamento para la Protección del ambiente contra la contaminación originada por la emisión de ruido	Regula las actividades de generación de contaminación por emisión de ruido.	Todos los artículos
Norma Oficial Mexicana NOM-085-ECOL-94	Norma Oficial Mexicana que establece los niveles máximos permisibles de emisiones a la atmósfera para fuentes fijas.	

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Tabla 4
Instrumentos estatales para la regulación de la actividad industrial en el Estado de Querétaro

Instrumento Jurídico	Descripción	Referencia
Ley Estatal del Equilibrio Ecológico y la Protección al Ambiente	El ordenamiento ecológico debe considerarse para la autorización de plantas o establecimientos industriales.	Art. 23 Fracc. VII
	Debe realizar la evaluación del impacto ambiental para zonas y parques industriales	Art. 32, Fracc. III
	Establece los criterios para el uso racional del agua y la prevención y control de la cotaminación de ésta.	Art. 72, Fracc. VII, Art. 81, Fracc. III
	Prohibe la emisión a la atmósfera de contaminaantes tales como humos, polvos, gases, vapores y olores; ruido, vibraciones, energía térmica y lumínica.	Art. 76, Art. 92
	Establece los criterios ecológicos para el manejo de los residuos sólidos no peligrosos.	Art. 101, Fracc. II
Ley de Desarrollo Industrial Estatal	El desarrollo industrial estará apegado a los criterios del ordenamiento ecológico del territorio de la entidad y la protección y el uso racional de los recursos naturales.	Art. 2, Fracc. I, IV
	Establece los criterios ambientales para la ubicación de los desarrollos industriales.	Art. 4, Fracc. I, V
	Establece los criterios ambientales para el giro o actividad industrial.	Art.5, Fracc. II,III, VI,VII,IX, XIII, XIV
	Establece los criterios ambientales para la autorización de parques y fraccionamientos industriales.	Art. 11, Fracc. I, IV, V, VII
	La actividad industrial debe cumplir con lo que establece la Ley General y Estatal del Equilibrio Ecológico y la Protección al Ambiente y las Normas Oficiales Mexicanas.	Art. 14, 18
	Establece que se debe evitar el mezclar desarrollo urbano con el industrial y el respetar suelos con vocación agrícola.	Art. 20, Fracc. I, II

Gestion environnementale des zones industrielles en Tunisie

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Abstract
In Tunisia the assessment of nuisances brought about by industrial pollution, and their impact on the environment, led to the setting up of a national strategy which has resulted in a series of institutional and statutory measures as well as in the implementation of a number of financial incentives. This article outlines the various measures adopted by the Tunisian authorities within a comprehensive environmental policy. The initial results are promising, but much more work still remains to be done

Résumé
En Tunisie, l'évaluation des nuisances liées à la pollution industrielle et de leur impact sur l'environnement a abouti à la mise en place d'une stratégie nationale qui s'est traduite par une série de mesures d'ordre institutionnel et législatif et par la mise en oeuvre de moyens d'incitation financiers. L'article présente l'ensemble des mesures prises par les autorités tunisiennes dans le cadre de la politique environnementale globale. Les premiers résultats sont encourageants mais beaucoup reste à faire.

Resumen
En Tunez, la evaluación de los perjuicios derivados de la contaminación industrial y de su impacto en el medio ambiente ha llevado a la implantación de una estrategia nacional que se ha traducido en una serie de medidas de orden institucional y legislativo, y en la aplicación de medios de incitación financieros. El artículo presenta el conjunto de las medidas tomadas por las autoridades tunecinas en el marco de la política medioambiental global. Los primeros resultados son alentadores, pero aún queda mucho por hacer.

La Tunisie a développé depuis quatre décennies des efforts considérables pour réaliser son développement économique et social. Pendant ce temps-là, il n'a pas été tenu compte des problèmes environnementaux, notamment ceux relatifs à l'industrie.

Aujourd'hui, convaincus que les impératifs du développement sont loin d'être contradictoires avec les exigences de la protection de l'environnement, les responsables déploient beaucoup d'efforts pour concilier développement et environnement.

C'est ainsi que la protection de l'environnement est devenue une priorité depuis le VIIIème Plan économique et social (1992-1996). Cela s'est reflété par l'évolution des crédits alloués pour la protection de l'environnement qui sont passés de 242 millions de Dinars Tunisiens (MDT) au cours du VIIème Plan (1987-1991) à 600 MDT pour le VIIIème Plan. Cela s'est traduit aussi par une stratégie nationale qui s'est fixée comme objectifs notamment:

- de confiner les phénomènes de pollution dans des limites acceptables, définies par des normes et soumises à des contrôles permanents ;
- de réhabiliter les zones polluées.

L'activité industrielle

Le secteur industriel en Tunisie comprend plus de 10.000 établissements classés dont environ 1200 sont considérés comme fortement polluants. Les activités industrielles considérées comme sources de pollution importantes sont notamment l'agro-alimentaire, la production de l'énergie, l'extraction et la transformation des phosphates, les tanneries et la production de l'acier.

Localisation des industries

La plupart des unités industrielles sont implantées sur le littoral et dans les principales villes du pays: Le Grand Tunis, Bizerte, Sfax, Gabès, Gafsa, Kasserine, Béjà et Sousse. Jusqu'à quelques années auparavant, l'implantation des grandes unités industrielles répondait aux critères économiques et de l'emploi. Quant aux petites unités, à l'origine de pollutions hydriques, elles se trouvent dispersées dans les zones où elles se sont implantées d'une manière anarchique.

Impact des activités industrielles sur l'environnement

Les dommages causés par l'industrie chimique (transformation des phosphates) à Gabès et à Sfax ont été à l'origine d'une prise de conscience profonde et ont déclenché une réflexion globale.

Partant du principe que les impératifs du développement et les exigences de la protection de l'environnement ne s'opposent pas, les autorités ont adopté une stratégie qui repose sur le concept de développement durable. Ce choix les a conduit à mettre en oeuvre une politique qui vise à la reconstitution et à la restauration des milieux et zones déjà fortement touchés par la pollution industrielle grâce à des programmes d'urgence. Sur le long terme, cette politique se donne pour objectif de contenir les pollutions dans des limites acceptables, définies par des normes.

C'est ainsi que des programmes urgents ont été développés dans les zones industrielles de Gabès et de Sfax (pollution de l'air et de la mer), de Ben Arous (rejets liquides), de Kasserine (rejets liquides), etc. Quant à la politique à long terme, elle s'est attachée à mettre un cadre institutionnel et juridique pour apporter une réponse la plus adéquate possible aux problèmes que pose le développement industriel dans le pays.

Cadre institutionnel

Plusieurs organismes et départements ministériels compétents ont essayé, dans la limite de leurs attributions et de leurs moyens, d'apporter une solution aux différents problèmes de l'environnement. Cependant leurs efforts n'ont pu aboutir en l'absence d'une politique globale et de coordination.

Pour corriger cette situation, la première réponse fut la création, en 1988, de l'Agence Nationale pour la Protection de l'Environnement (A.N.P.E) à qui a été confié, notamment, la lutte contre la pollution. La loi de création de l'A.N.P.E a institué un système de contrôle de la pollution et de sanction des atteintes à l'environnement.

En l'espace de 2 ans, l'A.N.P.E a identifié les principaux maux et élaboré un plan d'action national. L'importance des activités environnementales a amené le Gouvernement, en 1991, à créer le Ministère de l'Environnement et le transfert des directions techniques chargées de l'environnement des autres Ministères au Ministère de l'environnement. Au même moment, l'Office National de l'Assainissement (O.N.A.S), créé en 1974, est passé de l'Equipement à l'Environnement avec la redéfinition de ses attributions. Ici il est important de noter qu'à l'exception de quelques unités moins polluantes ou qui sont équipées d'unités de prétraitement, la plupart des installations industrielles déversent les eaux usées non traitées dans le milieu naturel.

A titre d'exemple, pour la zone sud de Tunis (Ben Arous) à forte concentration industrielle, seulement 13 % des unités sont raccordées au réseau d'assainissement. Une station d'épuration des eaux usées industrielles, la première du genre, est à l'étude pour cette zone.

L'ONAS a informatisé les données existantes

Figure 1
Etude environnementale – Tunisie

sur les rejets industriels en vue d'établir un cadastre des unités industrielles. L'ONAS prête assistance aux industriels pour la conception des unités de prétraitement, assure le contrôle et la surveillance des rejets des unités.

L'Agence Foncière Industrielle (A.F.I), organisme chargé de créer des zones industrielles et de les équiper en vue de les mettre à la disposition des promoteurs industriels, a développé son action dans le cadre du VIIIème Plan dans deux directions:

- réhabilitation des zones industrielles existantes,
- aménagement de nouvelles zones industrielles.

Depuis 1994 l'aménagement des zones industrielles n'est plus du seul ressort de l'A.F.I, les opérateurs privés sont aussi concernés.

Dans le cadre de leur mission, les opérateurs privés et l'A.F.I sont appelés à créer des mini zones réservées à un même secteur d'activité pour faciliter les opérations de protection de l'environnement, notamment les opérations de prétraitement.

Tout cela contribue a renforcer l'action globale pour la gestion de l'environnement et tout particulièrement la gestion des zones industrielles.

Cadre législatif

La lutte contre les nuisances est régie par plusieurs textes qui concernent notamment : la réglementation des rejets dans le milieu récepteur (exemple : 1982 décret réglementant la récupération des huiles usagées), la loi relative aux déchets et au contrôle de leur gestion et de leur élimination (10 juin 1996). Le contrôle et la surveillance des établissements classés sont régis par le code du travail. L'étude d'impact instituée depuis 1991 exige, en vue de l'obtention de toute autorisation d'unités industrielles, d'évaluer et de mesurer les effets, directs et indirects, à court, moyen et long terme, de ces unités sur l'environnement. L'étude d'impact s'inscrit dans la volonté de substituer une stratégie préventive à une stratégie curative. La prise en compte des problèmes environnementaux dès la conception des projets permet d'éviter les opérations de replâtrage souvent coûteuses et assure une intégration en amont des unités industrielles dans leurs zones, elles-mêmes aménagées à l'avance.

Autres instruments de gestion

Pour la gestion environnementale des zones industrielles, divers autres instruments ont été mis en place.

Fonds de Dépollution (FODEP)

Le fonds a pour objectif d'encourager les actions visant la protection de l'environnement contre la pollution industrielle, en finançant des projets d'installations destinées à réduire (station de prétraitement des eaux usées) ou à éliminer la pollution occasionnée par les entreprises industrielles. L'industriel doit présenter un schéma d'investissement comportant au mois 30 % de fonds propres.

Les investissements dans les projets concourant à la protection de l'environnement peuvent bénéficier :

a) du régime des incitations communes à tous les investissements,

b) du régime des incitations spécifiques aux investissements réalisés par les entreprises qui veulent éliminer leurs propres rejets polluants.

Les incitations comprennent la suppression de la T.V.A. du Droit de Consommation pour les équipements importés n'ayant pas de similaires fabriqués localement, une subvention de 20 % du coût de l'investissement (dans le cadre du FODEP).

Participation des industriels à la gestion des zones industrielles

L'implication des industriels dans la gestion des zones industrielles est initialement une recommandation issue de l'atelier APELL (processus pour répondre aux situations d'urgence en cas d'accidents industriels majeurs), organisé avec le concours du PNUE IE à Tunis en octobre 1991, dans le but d'amener l'industrie à mettre en place des systèmes d'assistance mutuelle pour répondre aux situations d'urgence. En janvier 1994, une loi relative à l'aménagement et à la maintenance des zones industrielles a institué les Groupements de Maintenance et de Gestion des zones industrielles (G.M.G). Ces groupements sont des associations d'intérêt collectif. Ils sont chargés dans chaque zone industrielle de la maintenance des services communs, de la gestion des équipements collectifs (ex : station de prétraitement) et de l'enlèvement des déchets industriels.

La priorité d'action des G.M.G est la réhabilitation des zones dégradées. Les groupements bénéficient de l'appui des autorités pour résoudre les problèmes nés de la dilution de la responsabilité et qui concernent la prise en charge des zones industrielles. Les G.M.G peuvent bénéficier du FODEP.

Le financement des opérations menées par les groupements est assuré au moyen de contributions provenant des occupants. La participation des occupants est fixée par le Conseil d'administration de chaque groupement, selon des critères tels que la nature de l'activité, la superficie occupée, le taux de consommation d'eau, le taux et la nature des déchets, etc.

Aménagement technique des zones industrielles et sauvegarde de l'environnement

Le décret n° 94-1935 du 19/09/94 fixe, dans le cadre d'un cahier des charges, les aspects techniques de l'aménagement des zones industrielles et les mesures nécessaires à la sauvegarde de l'environnement.

Pour les aménagements techniques, le lotisseur doit réserver des emplacements spéciaux pour l'implantation des équipements publics nécessaires à l'exploitation du lotissement comme les stations d'épuration, les réseaux et équipements de sécurité incendie, de bonnes conditions d'accessibilité à partir des voies publiques, etc.

Pour la sauvegarde de l'environnement, le cahier des charges impose diverses mesures au lotisseur, notamment une ceinture non constructible de 10 m qui doit être impérativement aménagée en zone verte. Cette ceinture peut être plus importante pour les zones proches d'établissements sensibles comme les hôpitaux, les écoles, etc. Les projets à réaliser dans un même lotissement doivent être compatibles quant à leur nature et au genre des nuisances qu'ils génèrent. L'Agence Nationale pour la Protection de l'Environnement (A.N.P.E) doit donner son agrément pour la liste des activités devant être admises dans le lotissement en question.

Pour chaque projet industriel au sein du lotissement, les acquéreurs doivent réserver 10 % de la superficie aux espaces verts.

Le branchement sur les réseaux d'assainissement est précédé de l'obtention d'autorisations de l'A.N.P.E et de l'O.N.AS, en cas de déversement des effluents dans le réseau public d'assainissement, de rejet des effluents dans le milieu récepteur ou lorsque des installations de prétraitement ont été exigées par l'étude d'impact.

Conclusion

Le sujet qui a été à la base de la prise de conscience en faveur de la protection de l'environnement en Tunisie est bien la pollution industrielle (Golfe de Gabès, Sfax, Tunis Sud, etc). L'approche adoptée pour apporter une réponse à ce problème a été progressive.

D'abord l'identification et l'évaluation des pollutions et de leurs impacts dans les zones les plus touchées, ensuite la mise en place de plans d'actions échelonnés dans le temps et touchant les aspects législatif et institutionnel et comportant des projets concrets de réduction des pollutions. Les premiers résultats sont encourageants. Il est certain que des progrès importants ont été réalisés dans le domaine de la gestion environnementale des zones industrielles, notamment par l'implication des industriels à travers leur structure associative (G.M.G), par le développement du cadre institutionnel et législatif et par des mécanismes d'incitation financiers. Les résultats obtenus semblent être minimes par rapport au travail gigantesque qui reste à accomplir.

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Managing environmental issues at large-scale industrial estates: problems and initiatives in central and eastern Europe and the former Soviet Union

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Abstract

A great many large-scale industrial sites are undergoing major transformation and restructuring in central and eastern Europe and the former Soviet Union. The EBRD's portfolio of investment projects increasingly includes such sites, presenting the Bank with environmental challenges related to their size, complexity and history. Both technological improvements and changes in management structure are needed in order to address environmental, and health and safety, issues. The EBRD requires "environmental due diligence" on all of its projects under preparation. Requirements vary, depending on the nature of each project.

Résumé

Une pléthore de gros sites industriels connaissent actuellement une profonde mutation et une restructuration à grande échelle dans les pays d'Europe centrale, de l'est et dans l'ancienne Union soviétique. De tels sites figurent de plus en plus souvent aux rangs des projets d'investissements de la Banque européenne pour la Reconstruction et le Développement et lui posent des défis écologiques de par leur taille, leur complexité et leur histoire. Pour faire face aux problèmes écologiques et aux questions d'hygiène et de sécurité qu'ils soulèvent, il est nécessaire de prévoir des améliorations technologiques et des modifications de la structure administrative. La BERD exige que tous ses projets en cours fassent preuve de "diligence obligée à l'égard de l'environnement". Les conditions à remplir varient en fonction de la nature de chaque projet.

Resumen

Un gran número de sitios industriales de gran escala experimentan transformaciones y reestructuraciones importantes en Europa Central y Oriental y la ex Unión Soviética. La cartera del EBRD para proyectos de inversión incluye cada vez más tales sitios, enfrentando así al Banco a retos relacionados con su tamaño, complejidad e historia. Para dirigir asuntos relacionados con el medio ambiente, la salud y la seguridad se necesitan tanto los avances tecnológicos como los cambios en la estructura de gestión. El EBRD requiere una "diligencia medioambioental suficiente" en todos sus proyectos en preparación. Los requisitos varían en dependencia de la naturaleza de cada proyecto.

Introduction

While the establishment of special zones for industrial development is under consideration in a number of the countries of central and eastern Europe (CEE) and the former Soviet Union (FSU), there are as yet few examples of industrial parks, estates, Free Zones or Export Processing Zones operating in this region. However, a very large number of large-scale industrial sites, which were characteristic of former Soviet industrial enterprise, are currently undergoing major transformation and restructuring. Large companies such as these often employ in excess of 100,000 workers. They often manage or are responsible for many other smaller enterprises, such as energy generation, water abstraction, waste disposal, town/city wastewater treatment plants, town/city transportation systems, schools and kindergartens.

Environmental issues on large industrial complexes

Environmental degradation in the countries of central and eastern Europe and the former Soviet Union is by now well understood. However, many of the environmental challenges facing large-scale enterprises are similar to those in most other countries of the world. While some issues can be addressed immediately, others must be part of a medium and long-term action plan and investment programme. The most significant environmental problems associated with all of these large industrial projects are broadly similar and can be summarized as follows:

- soil and groundwater contamination,
- air and water pollution,
- hazardous waste storage and disposal,
- occupational health and safety,
- process safety,
- environmental management systems,
- energy use,
- waste minimization,
- public participation,
- regulatory compliance.

Soil and groundwater pollution

Large-scale leaks of oil and on-site disposal of solvents, chemicals, heavy metals and polychlorinated biphenyls (PCBs) over many years usually represent the most significant problems. The contamination of groundwater can render aquifers unusable both for drinking and for industrial purposes and raise serious health concerns (and potentially significant liability issues). Pre-treatment of industrial wastewater may be needed where heavy metals or toxic chemicals threaten the quality of ground or surface water.

Air pollution

Large-scale industrial plants are a major source of air pollution and a major contributor to poor urban air quality. Along with emissions from the industrial processes, many of these plants have their own power and heat generation plants, which often supply the local town or city. The pattern of relatively heavy reliance on poor-quality coal and on *mazut* (Russian heavy fuel oil) is the most significant cause of urban air pollution problems, resulting in excessive quantities of sulphur and particulates being discharged into the air. Initial priorities should include improved dust controls and the substitution, where possible, of gas for coal or heavy oil in power plants.

Water pollution

As in western Europe, many rivers in central and eastern Europe and the CIS are seriously polluted downstream of major industrial plants. Most large-scale industrial plants discharge large volumes of effluent containing significant amounts of heavy metals, organic chemicals and high values of COD and BOD. Municipal treatment plants (where they exist) are often inadequately equipped and can be a significant cause of serious contamination of the receiving waters.

Hazardous waste storage and disposal

Reliable information on the volumes and composition of hazardous waste generated by large industrial plant is rare, especially since a significant proportion of industrial hazardous waste is disposed in municipal landfills. The unsafe co-disposal of hazardous and domestic wastes often occurs in unlined landfills which do not adequately protect against seepage into groundwater supplies. Toxic wastes stored at industrial sites can also

contaminate nearby soil and groundwater supplies. Because of the increasing shortage of landfill capacity, inadequate enforcement procedures, and rising disposal costs, illegal dumping of both hazardous and non-hazardous wastes is a problem in some areas of the region.

Occupational health and safety

There is a high correlation between locations with severe health concerns and large industrial plants in central and eastern Europe and the CIS. This is because the most damaging environmental health effects are associated with human exposure to dust, toxic gases and heavy metals (particularly lead), all of which may be emitted in large quantities from industrial sources. Furthermore, some of the most dramatic environmental health problems have emerged in locations where "bad town planning" has compounded the impact from industrial sources. High-rise apartments, schools and hospitals are built next door to industrial plants without an adequate "sanitary zone" to protect them. As these polluting industries affect both the health of local populations and that of the employees, a remediation strategy targeting environmental health problems will also be successful in controlling workplaces with significant occupational health problems. In many cases, however, the only solution will be to relocate the industrial plant.

Energy efficiency

Energy conservation in the region is clearly a key component of sustainable development. Energy price reform is considered in all of the Bank's energy projects, as realistic energy pricing is the basis of financial viability. A typical large industrial plant in central and eastern Europe and the CIS consumes considerably more energy than its Western counterpart. The poor performance is due principally to the cost of steam and power imported into the plant and the ineffective operation of fired heaters and lack of thermal insulation. A comprehensive energy audit may well be appropriate, and there is likely to be considerable scope for energy improvements. Where possible, EBRD projects incorporate energy-saving initiatives in large-scale projects. Many projects include upgradings in thermal power and district heating stations to improve combustion efficiencies, repairs to power and heating distribution systems, metering stations for bulk gas deliveries, and heat meters.

The Bank is firmly committed to fostering investment projects aimed at reducing the consumption of energy in all sectors, and particularly in industry. To implement this new strategy, a specific Energy Efficiency Unit has been established. Several important energy efficiency operations are already close to fruition:

- direct financing of energy saving investments in some industrial enterprises;
- dedicated energy efficiency credit lines to local retail banks to finance small-scale energy conservation projects;
- participation in joint ventures aimed at producing energy efficiency equipment;
- financing or refinancing of energy service companies and third-party financing entities.

Fire damage

Fire and explosion, particularly in the chemical sector, represent one of the most serious (and expensive) risks for large industrial sites. In the past, fires have been the cause of much of the most significant environmental damage. In addition to the poor condition of chemical and petroleum storage tanks, underground fire water tanks and piping are often corroded and are prone to leaks, resulting in reduced fire water pressure. Fire water is often diverted for other uses, leaving an uncertain availability in the event of a fire. This can lead to a situation in which a facility is uninsurable and liable to excessive fire damage. EBRD projects generally incorporate the refurbishment of fire mains and firefighting equipment and other safety measures.

Environmental management

Not only are technological improvements necessary but, perhaps more fundamentally, management changes are often needed. Many of the environmental problems stem from bad "housekeeping", and significant improvement can be achieved from "low-cost/no-cost" solutions, particularly in the area of waste minimization and disposal. Comprehensive systems of environmental management in the EBRD's region of operations are still rare, and responsibility for environmental matters commonly remains at line engineer level, whereas in western Europe ultimate environmental responsibility is increasingly found to lie with senior management.

Public information

Many large-scale industrial complexes are located in centres of high population density and often in city centre locations. A public information programme often needs to be established to inform local residents of the intended modernization process and of environmental and safety improvements, and to implement a formal procedure for communicating with the public. In cases where off-site contamination may have an impact on regional groundwater or surface water, a special public information component can form part of the remediation programme.

EBRD's approach and initiatives

Environmental due diligence

The EBRD requires environmental due diligence on all of its projects under preparation. Requirements vary, according to the nature of the project. Environmental audits are required to determine the environmental status of a facility, property or operation and to identify regulatory compliance status, past or present problems, and potential environmental risks and liabilities associated with the project. Based on the results of the audit and any other environmental investigations (impact assessments, risk assessments, etc.), an Environmental Action Plan (EAP) which has to be satisfactory to the Bank is normally required to address the issues identified.

The overall objective of the Environmental Action Plan is to bring a company's operations into compliance with applicable regulatory requirements in the country. It may also include action on long-term compliance issues, such as future regulatory requirements and harmonization with EU or with other international legal requirements, standards and practice. In addition, the Action Plan may include measures to gradually improve the company's environmental performance over and above regulatory compliance, in particular in areas such as energy efficiency or cleaner production. Such environmental enhancement objectives, while voluntary, will often have a positive impact on the medium and long-term efficiency and profitability of the plant.

A typical project will raise a number of regulatory compliance issues. During environmental investigations, the enterprise's emissions, waste streams, and general compliance status will be compared to international industry standards. This comparison identifies whether or not the facility is operating within its legal requirements and how those requirements compare to an international standard.

EBRD's large-scale industrial projects

Increasingly, the EBRD's portfolio of investment projects has included large-scale industrial sites, presenting the Bank with particular environmental challenges because of their size, complexity and history. Over the past year, for example, the EBRD has approved corporate loans to KamAz, GAZ, Fergana Refinery and Pliva Pharmaceuticals, which represent some of the largest industrial complexes in central and eastern Europe and the CIS.

KamAz

KamAz, at one time the world's largest manufacturer of heavy trucks, has a manufacturing complex covering 57 square kilometers at Naberezhnyye Chelny, east of Kazan in Tatarstan in the Russian Federation. The foundry plant alone is the size of Manhattan Island and is reportedly the largest foundry in the world. In April 1993 KamAz had a major fire that completely destroyed the company's engine plant. The EBRD's loan for corporate restructuring will not only enable the company to rebuild its engine plant, but will also greatly improve environmental and health and safety management.

GAZ

The corporate loan to GAZ, Europe's largest automotive factory, located in Nizhny Novgorod, east of Moscow, will help the company purchase a "state-of-the-art" paint facility and make a significant contribution to the reduction of volatile organic compounds (VOCs), the most significant environmental problem at the facility. VOCs can be carcinogenic and can also contribute to global warming.

Fergana Refinery

At the Fergana Refinery in Uzbekistan extensive investigations required by the EBRD revealed significant environmental and health and safety problems, principally due to large-scale leakage of

oil over many years which had resulted in major soil and groundwater contamination. Much of the Bank's investment will address environmental and safety issues through the reduction of sulphur emissions, the purchase of a gas-fired incinerator, implementation of a new safety flare system, the refurbishment of the fire mains system, and the upgrading of railcar loading and unloading. An enhanced oil recovery and remediation programme has been developed and now forms part of the Environmental Action Plan. An international environmental advisor has been appointed to help implement the environmental programmes, and an international remediation specialist will be hired to improve the efficiency and effectiveness of the oil recovery programme.

Pliva Pharmaceuticals

The Pliva operation involved a loan and convertible debt to Pliva to assist in the construction of a modern Azithromycin (antibiotic) production plant and to finance other capital expenditure projects. Pliva is Croatia's oldest pharmaceutical company and, in terms of sales, the largest in central and eastern Europe. The company's manufacturing operations are carried out at nine different locations and cover bulk pharmaceuticals, foodstuffs, animal health products, agrochemicals, cosmetics and hygiene products. The Azithromycin plant will move production from its current downtown location in Zagreb to a new location which was completed in 1987. This will have a major positive environmental impact, particularly in reducing air emissions and relieving traffic congestion.

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Why publish technical guidelines for environmental management of industrial estates?

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Abstract

There are more than 12,000 industrial estates and parks around the world, some of which contain as many as 1000 businesses. The potential for industrial accidents and cumulative environmental impacts therefore looms large. In view of this potential, and recognizing an opportunity to promote sustainable industrial development, UNEP IE convened a meeting of experts in April 1995 to consider a technical manual concerning environmental management of industrial estates. The manual, currently in preparation, will address environmental, health and safety concerns, guiding principles for environmental management, a management framework including a discussion of appropriate environmental services, and guidelines for new and existing industrial estates. It will make the case that adopting a comprehensive environmental management framework reduces environmental impacts, minimizes risks and liabilities, and enhances the sustainability of the estate.

Résumé

Il existe plus de 12.000 zones et parcs industriels dans le monde et certains d'entre eux comptent jusqu'à 1000 entreprises. Le risque d'accidents industriels et l'impact cumulé sur l'environnement est donc une menace bien réelle. Le PNUE IE, conscient de ce risque et reconnaissant là une opportunité de promouvoir un développement industriel durable, a organisé une réunion d'experts en avril 1995 afin d'envisager la rédaction d'un guide technique ayant trait à la gestion de l'environnement dans les zones industrielles. Ce guide, actuellement en préparation, traite des problèmes liés à l'environnement, l'hygiène et la sécurité ; il énonce des principes directeurs pour la gestion de l'environnement et propose un système de gestion qui s'appuie sur des prestations environnementales appropriées, et fournit des indications précises pour les zones industrielles nouvelles ou existantes. Il démontre que, par l'adoption d'un plan global de gestion de l'environnement, on peut réduire l'impact sur l'environnement, minimiser les risques et les responsabilités et renforcer la viabilité à long terme d'une zone industrielle.

Resumen

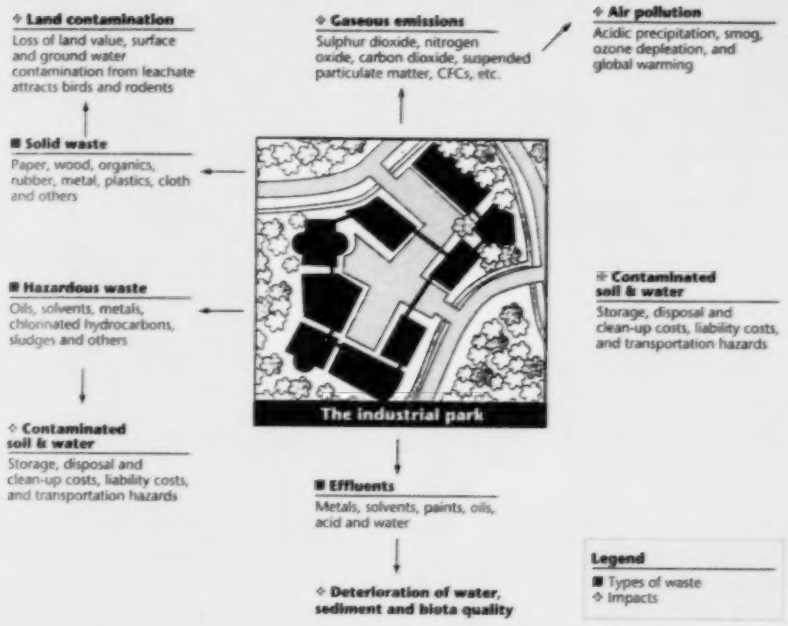
Existen más de 12.000 emplazamientos y parques industriales en todo el mundo, entre los cuales algunos contienen hasta 1000 empresas. Por ende, el potencial de accidentes industriales y de impactos medioambientales acumulativos parece muy amplio. Teniendo en cuenta este potencial y reconociendo una oportunidad para promover el desarrollo industrial sostenible, UNEP IE convocó a una reunión de expertos en abril de 1995 para considerar un manual técnico relativo a la gestión medioambiental de terrenos industriales. El manual, actualmente en proceso, incluirá principalmente algunas pautas sobre asuntos medioambientales, de salud y seguridad, para la gestión medioambiental, un marco de gestión que incluye una discusión sobre servicios medioambientales adecuados y pautas para nuevos terrenos industriales y terrenos industriales ya existentes. Al parecer, el hecho de adoptar un marco de gestión medioambiental extenso reduce los impactos medioambientales, disminuye los riesgos y las responsabilidades y estimula el mantenimiento del emplazamiento.

Industrial estates have become fixtures of the global landscape. In fact, they are so plentiful and definable, estates could be viewed as biomes in ecological terms. According to the Industrial Development Research Council, there are in excess of 12,000 industrial estates, parks and export processing zones around the world.

Established initially in the early part of the twentieth century in the United Kingdom and the United States, estates have emerged as the major feature in industrial development. The United Nations Industrial Development Organization (UNIDO) recognized their significance and was instrumental in forming the World Export Processing Zones Association in 1978. Some estates encompass thousands of businesses and tens of thousands of workers, occupying as much as 10,000 hectares of land. Their interaction with the other components of the biosphere is now such that they must be integrated more carefully with the carrying capacity of areas and regions in which they are located.

All sectors of industry are represented in these estates, with the result that every conceivable type of air, liquid and solid waste is generated. With 100,000 chemicals in commerce, pollution problems are becoming increasingly complex. In addition, the construction of estates has compromised sensitive and ecologically valuable habitats and species in many countries. The global nature and extent of the environmental impacts of the development and operation of industrial estates can only be surmised. It is known, for example, that certain estates have been established by expropriating mangrove wetlands and converting agricultural land.

Figure 1
Problems of industrial pollution


Land contamination
Loss of land value, surface and ground water contamination from leachate attracts birds and rodents
Gaseous emissions
Sulphur dioxide, nitrogen oxide, carbon dioxide, suspended particulate matter, CFCs, etc.
Air pollution
Acidic precipitation, smog, ozone depleation, and global warming
Solid waste
Paper, wood, organics, rubber, metal, plastics, cloth and others
Hazardous waste
Oils, solvents, metals, chlorinated hydrocarbons, sludges and others
Contaminated soil & water
Storage, disposal and clean-up costs, liability costs, and transportation hazards
The industrial park
Contaminated soil & water
Storage, disposal and clean-up costs, liability costs, and transportation hazards
Effluents
Metals, solvents, paints, oils, acid and water
Deterioration of water, sediment and biota quality
Legend
Types of waste
Impacts

Many types of wastes are released to air, water and soil. For most business people, the wastes that receive the most attention include various chemicals that find their way into effluents, emissions, and soil and hazardous waste.

A variety of techniques have been utilized to attract industries to settle in estates. These include readily accessible infrastructure such as water supply, sewage, roads, buildings and energy supply, economic incentives and relaxed fiscal regimes, and simplified siting and approval procedures. Only recently have environmental factors such as emission regulations and Environmental Impact Assessment become significant. Although there are a number of manuals and guides for the design and development of industrial estates and business parks, most of them emphasize aesthetic matters with some attention to pollution control. However, environmental services are increasingly being recognized as benefits for marketing purposes rather than negative influences on the location of industry.

The1995 UNEP meeting

It was with this background in mind that UNEP IE convened a meeting of experts in April 1995 to explore the nature of environmental risks associated with industrial operations in large estates as well as approaches for incorporating environmental considerations into the estate planning and management framework. Environmental issues identified at the meeting as being of particular importance were: air emissions; effluent discharges; solid waste disposal; hazardous waste management; soil contamination; noise and radiation; management of toxic chemicals; industrial accidents; chemical and fuel spills; habitat destruction and loss of biodiversity; and global climate change

A number of case studies from Canada, Sri Lanka, Thailand, China, India and the United Arab Emirates (Dubai) were presented at the meeting. These estates and export processing zones represented a range of management systems and services for addressing environmental risks. They included the use of environmental impact assessment prior to the planning and construction of industrial estates; zoning of districts within estates for various sectors of industries and activities; periodic environmental reviews and inspections; a cooperative private sector venture providing industrial waste treatment to member companies; and the establishment of an industrial park ecosystem, the latter representing the latest evolution in the design and operation of industrial estates. The case studies also presented strategies for meeting the governmental or estate objectives for environmental quality, such as rescinding economic incentives and basic services to force compliance and levying fees on companies based on the quantity of pollution discharged.

Clearly there exist a range of systems and services among the many estates in operation today, although their success has not been evaluated. There is an expectation that the number of estates will increase, especially in the rapidly industrializing countries. Building on the initiatives already taken by estate management around the world, UNEP IE concluded that a technical manual would assist managers of existing estates while providing useful guidance to government agencies and private development companies beginning the process of establishing new estates.

Description of the manual

The manual, which will be distributed in 1997, will address such issues as the need and benefits of environmental management of industrial estates, the critical environmental, health and safety concerns, guiding principles for the design and operation of estates, components of an environmental management framework, and environmental guidelines for new and existing industrial estates.

In its documentation, UNIDO provides an extensive list of benefits of industrial estates for economic and industrial development as well as urban and regional planning. Unfortunately, none of the benefits relates to the environment, except perhaps in an indirect manner. This manual attempts to document some of the environmental benefits. These would include:

- improving the efficiency of land and water use;
- reducing infrastructure costs (economic and environmental);
- reducing risks to human health and safety;
- conserving natural resources;
- reducing treatment costs and risks;
- reducing environmental liabilities; and
- improving the public image of companies operating within the estate.

It is believed that these benefits will accrue to the companies, the estate as a whole, neighbouring communities and the environment.

A wide range of environmental, health and safety issues are encouraging government agencies and estate managers to adopt a comprehensive environmental management framework. There are issues of land use, particularly those surrounding the loss of ecologically valuable dry and wetland habitat critical to maintaining biodiversity. In some countries, the land which is appropriated is valuable agricultural land. A second category of issues are linked to water use. Fresh water is a valuable resource which must be carefully husbanded. A comprehensive management plan should result in more efficient use of water.

Energy production and use is a third category of issues. The depletion of non-renewable resources, and the by-products of the consumption of fossil fuels, present significant economic and environmental risks. Estate development and management agencies can influence the rates of depletion and consumption through energy conservation and promotion of alternative, renewable energy sources. Pollution and wastes continue to be generated in excessive quantities by industry worldwide. Pollution can be reduced through cleaner production technologies and techniques, while wastes are increasingly being viewed as resources which can be reused, recycled, or used as the feedstock for nearby industries.

Perhaps the most significant concern associated with agglomerations of industries is the potential for industrial accidents such as occurred at Bhopal and Basel. The transportation, storage, manufacture and disposal of numbers of chemicals and mixtures of wastes in proximity to communities warrants particular attention to the need for prevention, preparedness, and emergency response capability.

The manual addresses principles which have evolved in the past few years to guide environmental management into the twenty-first century. It refers to such documents as the Business Charter for Sustainable Development and the Responsible Care Principles of the chemical manufacturing industry. In particular, the manual emphasizes seven concepts or principles which ought to underlie environmental management of industrial estates. These are environmental planning, especially the application of environmental impact assessment; integration, focusing on environment and economy, cross-media approaches, management responsibilities, and multi-sectoral integration; the precautionary principle, with its "better safe than sorry" philosophy; cleaner production, including resource recovery; ecological design; total quality environmental management; and industrial ecology, with emphasis on symbiosis or cooperation in environmental management.

The following critical components of the environmental management framework are discussed in the manual:

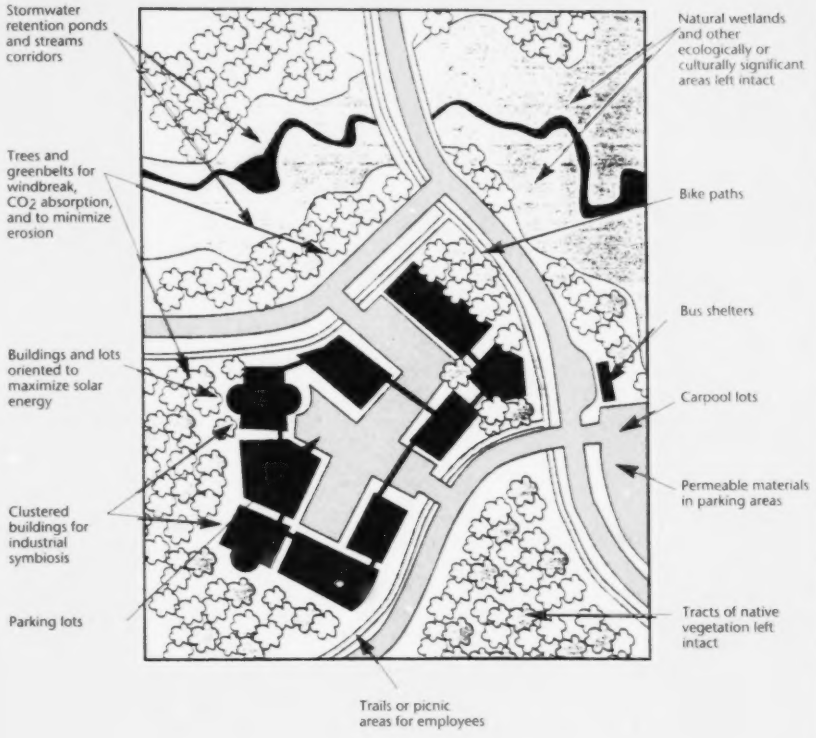
1) developing an environmental policy for the estate;
2) developing environmental performance objectives;
3) providing environmental services;
4) financing environmental management;
5) emergency prevention and preparedness;
6) recognizing environmental achievement;
7) marketing environmental quality;
8) selecting compatible industries;
9) managing environmental responsibilities.

The manual discusses a number of environmental services which are or could be provided by estate management agencies or companies for the benefit of the estate as a whole. These services include:

- providing water services, including technical support for conservation;
- providing energy, including technical support for conservation;
- solid waste collection and disposal;
- sewage collection and treatment;
- emergency preparedness and response;
- industrial waste collection and treatment;
- hazardous waste storage and treatment;
- environmental monitoring;
- laboratory service;
- waste exchange clearinghouse;
- audit services for energy, water, waste, and health and safety;
- multi-material resource recovery centre;
- environmental management training and advisory services.

The section on responsibilities identifies the different responsibility centres, with examples of approaches taken in three jurisdictions: Dubai in the United Arab Emirates, Thailand and Japan. Aspects of the regulatory and economic framework which supports management are also discussed.

Figure 2
Applying the guidelines: environmental design possibility for site development


Stormwater retention ponds and streams corridors
Trees and greenbelts for windbreak, CO_2 absorption, and to minimize erosion
Buildings and lots oriented to maximize solar energy
Clustered buildings for industrial symbiosis
Parking lots
Natural wetlands and other ecologically or culturally significant areas left intact
Bike paths
Bus shelters
Carpool lots
Permeable materials in parking areas
Tracts of native vegetation left intact
Trails or picnic areas for employees

The report will present specific guidance on the planning and design of new industrial estates as well as the operation of existing estates. Emphasis is placed on new estates, and guidelines are provided on site selection, integrated planning, environmental and socio-economic impact assessment, site layout, density, infrastructure and construction. The section on existing estates discusses the transition between "what is" and "what should be".

The manual concludes that there are financial and environmental benefits, based particularly on waste reduction and cleaner production studies involving more than one company. It acknowledges that more remains to be done to quantify the full benefits of a comprehensive environmental management framework. The manual will include a bibliography of relevant documents and papers, and several appendices including guidelines recommended by the Indonesian Ministry of Industry for environmental impact analysis of industrial estates in that country.

A living document

The draft manual will now undergo a review process involving the group of experts who convened in Paris at UNEP IE's offices in 1995 before it is distributed. Environmental management of industrial estates will evolve as the principles and guidelines begin to be applied, and so it is expected that this manual will be a living document, undergoing a metamorphosis as experience with it is gained.

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Evaluation of pollution in Hanoi and recommendations for mitigating it

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Abstract

Vietnam is experiencing rapid urbanization and industrialization. A 1992-95 study of the city of Hanoi considered air and water pollution, solid waste, and noise pollution. Impacts on public health and agricultural production were assessed. A number of ways to mitigate Hanoi's pollution problems have been proposed.

Résumé

Le Viet Nam connaît une urbanisation et une industrialisation rapides. Une étude menée de 1992 à 1995 dans la ville de Hanoi s'est penchée sur la pollution de l'air et de l'eau, les déchets solides et les nuisances sonores. Les impacts sur la santé publique et la production agricole ont été évalués. Il est proposé un certain nombre de solutions qui permettraient d'atténuer les problèmes de pollution de la ville d'Hanoi.

Resumen

Vietnam experimenta una urbanización e industrialización rápida. Un estudio de 1992-95 de la ciudad de Hanoi considera la contaminación del aire y del agua, los desechos sólidos y la contaminación sonora. Se analizan los impactos sobre la salud pública y en la producción agrícola. Además, se proponen un cierto número de formas de aliviar los problemas de contaminación de Hanoi.

Object of the study

Our country, which is in the process of industrializing and urbanizing, is shifting from a planned centralized economic system to a market-oriented economy under government control. Environmental protection and sustainable development of urban and industrial areas have become important issues in Vietnam. Efficient action is therefore needed to prevent pollution and to protect and improve the environment.

The Research Thema KT. 02.03 was part of the State Scientific Research Programme KT. 02 on Environmental Protection for the period 1992-1995, carried out by the Centre for Environmental Engineering of Towns and Industrial Areas, Hanoi University of Civil Engineering. The three northern cities of Hanoi, Haiphong and Viet tri were studied.

Hanoi is a typical large city in the Red (Hong) River Delta. Haiphong is a typical large city in the coastal area, with a sizeable port, and Viet tri is a typical non-coastal city. All three have been undergoing rapid industrialization and urbanization and are faced with urgent environmental problems.

The object of Thema KT. 02.03 was to study and evaluate the sources of air and water pollution, solid waste, and noise pollution in these cities and, based on the findings, to evaluate the pollution rate and produce maps with pollution indicators that could be compared with the basic environmental criteria. General technical measures could then be recommended to reduce pollution and improve the general environment.

Study methods

The following methods were used:

- A questionnaire was prepared on sources of pollution, and on the relations between pollution and agriculture and between pollution and human health;
- A survey was made of water, air and noise pollution in industrial areas and cities;
- Comparisons and analyses were carried out, for instance of pollution-related diseases in polluted vs. non-polluted areas of the same city;
- A model was used to predict future urban environmental impacts;

A Gaussian model was used for air pollution,[1] and the Florov-Rodzider model was used for water pollution.[2]

Findings

In Hanoi there are approximately 274 enterprises, of which 68 in the inner city are significant sources of pollution. There are 540 service units, 450 handicraft cooperatives, 3350 production groups, 20 hospitals, 11,000 double-vaulted and bucket latrines, and tens of thousands of charcoal stoves.

The majority of factories are located in the two districts of Dong Da and Hai Ba Trung, which are thus the two most polluted districts. They are followed by the Ba Dinh district, where the pollution rate is about a third as great, and the Hoan Kiem district, where industrial pollution is insignificant. Thanh tri is the most polluted of the five suburban districts, followed by Dong Anh and Gia lam. In the Tu liem and Soc Son districts industrial pollution is also insignificant. Industrial wastes in inner Hanoi are more substantial than those in suburban areas. The inner city is mainly polluted by emissions from the chemical, textile and food processing industries.

Traffic is a great source of air and noise pollution in Hanoi. While automobiles are not very numerous, the streets are in poor condition. Trenches and culverts are always under repair. Dust and noise levels are high, with much construction. Other pollution sources of major concern in Hanoi are hospitals, slaughter houses, sub-standard latrines, and charcoal stoves.

Air pollution

If we consider air pollution in June, July and August as typical on average of summer, and that of December, January and February as typical of winter, we can make the following remarks concerning the four districts of inner Hanoi:

Hai Ba Trung district

The three areas most affected by air pollution in the Hai Ba Trung district are the residential quarters around the factories in Mai Dong-Minh Khai (chiefly the Textile Factory 8th of March and the Mai Dong Mechanical Plant), the area around the Chemical Plant Three Goods in Bach mai Street, and the Hanoi Liquor and Beverage Plant in Lo Duc Street.

As compared with the environmental standards stipulated before 1995,[3] the dust concentration in part of the Bach Khoa quarter and at Cau Den Gate is four to 16 times the safety limit, and that in the fast hamlet, the Dong Nhan ward, and the Truong Dinh ward is two to four times the safety limit. In the Pham Dinh Ho ward, where the boiler of the Hanoi Liquor and Beverage Plant is fully operational, the dust pollution rate is similar.

The SO_2 concentration in the Mai Dong-Minh Khai area is similar to that of Hanoi Liquor and Beverage and the Winter-Spring Knitting Factory, that is, eight to 16 times the safety limit. The SO_2 concentration around the Chemical Plant Three Goods is three to eight times the safety limit.

The CO concentration around the chemical plant is 16 to 23 times the safety limit; that in Mai Dong-Minh Khai, as well as around Hanoi Liquor and Beverage, is five to 15 times the safety limit.

Dong Da District

Most seriously affected by pollution in the Dong Da district are the industrial complex of Thuong Dinh and the surrounding residential quarters in the wards of Thuong Dinh, Thanh xuan Nam, Thanh xuan Bac, Khuong thuong, and the village of Nhan chinh, where the dust concentration is two to four times, SO concentration twelve to 18 times, and CO concentration two to six times the safety limit. The wards of the Thinh Quang, Kim Ma and Quoc Tu Giam quarters are less affected by pollution.

Ba Dinh District

The adjacent wards near the Truc Bach Paper Mill, the Thuy Khe Tannery, and Hanoi Liquor and Beverage are subject to pollution. The area affected by pollution here is smaller, and the pollution rate is lower. The dust concentration is one to two and a half times and the SO concentration two to seven times the safety limit. The Ba Dinh district is almost unaffected by CO.

Hoan Kiem District

The Hoan Kiem district is more or less affected by pollution from the Hong Ha Stationery Plant, the Ngo Gia Tu Automobile Workshop and the Hanoi Plastic Factory. But the impacts are only local and not as serious as in other districts.

Water pollution

In Hanoi there is a system of integrated canals, rivers and lakes for the discharge of three kinds of wastes: domestic sewage, industrial waste and storm water. The total length of underground pipe is 140 km. There is 30 km of open canal and four rivers totaling 40 km, the latter being the main discharge axis (a new river/canal is under excavation).

With the exception of the Red River and a section of the Nhue River (from the Lien Mac sluice gate to the Buou Bridge), which are not involved in sewage and drainage, Hanoi's entire sewage/drainage system is heavily polluted by domestic and industrial wastes. As the sewage is not treated, the concentration of water pollutants at the outlet is very high:

BOD: 50-190 mg/l
NH^+: 3-25 mg/l
COD: 90-495 mg/l
Dissolved oxygen: less than 1 mg/l

Wastewater from hospitals and industry in the city is mainly discharged directly to sewage canals, rivers and lakes without treatment. Some of the treatment facilities provided to some factories have not been working at all. A local sewage treatment system at the Bank Printing House is, however, operating well.

River pollution

The To Lich River has the lowest rate of wastes as compared with other rivers. With the exception of the first portion and another portion extending from the Cau Moi Bridge across the Thuong Dinh industrial area, this river is polluted to the Oligosaprophic level. The BOD along the river is within the range 63.5 - 61 – 38.5 - 9.5 - 8.5 - 10 - 12 - 11 mg/l.

The Lu River is integrated with a series of successive canals, rivers and lakes to form a complete and typical system for draining Hanoi's sewage. There is a self-cleaning process of canals-rivers-lakes. Most of the Lu River is polluted to Alpha-mezosaprophic level and the BOD level varies with the flow: 27 - 25 - 16 - 21 mg/l. The last stretch of the river is polluted to Beta-mezosaprophic level.

The Set River flows across populous residential quarters. It collects sewage with a high concentration of pollution. The entire length of the river, from beginning to end, is polluted to Polysaprophic level. Its BOD varies with the flow as follows: 180- 162 - 81 - 72 - 35 mg/l.

In spite of the self-cleaning process, the BOD level of the Kim Nauu River is still very high. In the first section of three to five kilometres, the BOD varies within the range 125 - 100 - 85 - 73 - 45 - 32 mg/l and the pollution is up to Polysaprophic level. This is where sedimentation and fermentation in anaerobic conditions occur, giving rise to such gases as H_2S, CO and CH_4. It might be said that this is the most polluted section of river, as compared with all other canals, rivers and lakes in Hanoi.

Lake pollution

Hanoi has 20 lakes, with a total area equivalent to 592 ha. The difference in water levels between the rainy and dry seasons is 0.5-1 m, and sometimes up to 1.5 m, favouring the water regulation and self-cleaning function.

A number of lakes are heavily polluted due to the large amount of sewage. Their beds gradually rise to 0.5-1 m due to sedimentation, chiefly in such lakes as Giam, Van chuong, Linh Quang, Bay Mau and Ba Mau. In general, the water samples taken approximately 5-10 m from the sewage discharge outlet have a waste suspension of 0.5-2 mg/l, while samples taken at the other end have a waste suspension of 50-80 mg/l, BOD ranging from 10-15 mg/l, and dissolved oxygen from 6.5-8.7 mg/l. At the Ngoc Khanh and Giang Vo lakes, which are becoming contaminated, pollution is at the Betamezosaprophic level.

In other lakes (Thu Le, West Lake, Thanh Cong, Dong Da) which are large, and where there is little sewage discharge, pollution is at the Oligosaprophic level. In general, pollution in rivers and lakes is within the safety limits prescribed in the standards, in terms of BOD or suspension.

Local flooding in Hanoi

Storms with 50 mm/h precipitation already cause local floods in various areas of Hanoi. Rainwater suspension samples taken from the gutter varied from approximately 50 to 1600 mg/l, averaging 500 mg/l. When there is local flooding, dirty water overflows from the gutters and canal and looks repulsive. When it withdraws, a thin, sticky layer is left behind on the road.

Table 1
Patients in polluted vs. non-polluted areas in the same district

Order	Locations	Number of times more patients in polluted area	Symptoms of diseases
1	Van Dien area	3.8-7.2 times	symptoms of diseases related to the respiratory system due to air pollution, and of those related to the digestive system and to the skin due to water pollution
2	Thuong Dinh area	3.8-7.0	
3	Bat trang Village (Gia lam)	2.6-2.8	
4	Lien Ninh Village (Thanh Tri)	2.1-6.0	

Pollution by solid wastes

The daily discharge of solid wastes in Hanoi is about 2000 m³ and, on festive occasions, might be as much as 3000 m³/day. There are, in addition, dozens of tonnes of night soil per day from about 11,000 double-vaulted and bucket latrines. Though a small-scale solid waste treatment plant has been constructed in Cau Dien, it is barely operating. The basic practice in Hanoi is still to dump waste in deep holes for slow decomposition, and these holes are not always in compliance with hygiene regulations. The toxic wastes from hospitals and factories are not properly classified for specific treatment.

Noise pollution

According to the survey data, approximately 40-50 per cent of factories are affected by noise pollution.

The noise level recorded in the large streets of Hanoi is 78-80 dBA. If no positive measures are taken to check the level of traffic noise, it is forecast that Hanoi will experience a high level of noise pollution in the foreseeable future.

Impacts on health

The impacts of pollution on the health of the community are obvious. They are demonstrated, by example, by the higher percentage of patients in polluted as compared with non-polluted areas in the same district (see **Table 1**).

Impacts of industrial wastes on agriculture

Based on testing for eleven chemical and ten biological factors in rice fields around the Van Dien, Thuong Dinh, Duc Giang and Cau Duong industrial areas, and on survey findings for plants and animals under cultivation, sewage promotes the growth of microorganisms, enriches soil fertility, and raises agricultural production, but sulphur and heavy metals are deposited in the soil. Fortunately, their presence is not evident in cereals and other foodstuffs. Chemical plant discharges of waste gas and sewage have had obvious negative impacts on agriculture and breeding.

Recommendations on general technical measures to reduce pollution and protect the environment in Hanoi

It is recommended that:

1. No more industrial factories are to be located in the two districts of Dong Da and Hai Ba Trung in particular, and in the inner city in general, unless they are pollution-free. Even the extension of existing factories shall be considered carefully, with great attention paid to environmental protection measures. Three factories (the Chemical Plant Three Goods, the Thuy Khe Tannery and Hanoi Liquor and Beverage) shall either be moved out of the inner city or turned into pollution-free enterprises.
2. Further investment shall be made in improving chemistry, textiles and foodstuffs production technology, chiefly in these processing lines: boiler, electroplating, dyeing and sewage treatment. Further reconditioning of waste treatment facilities shall be made, chiefly those serving factories within the Thuong dinh industrial area, Thuy Khe Tannery, Hanoi Liquor and Beverage, the Textile Factory Eighth of March, Halida beer, synthetic paint, the soap factory and hospitals.
3. The impacts of the master plan development in Hanoi till the year 2010 on the environment shall be evaluated, and readjustments made if necessary in order to protect the environment.
4. There shall be registration and monitoring of all sources of pollution, chiefly at plants, factories and hospitals.
5. There shall be reconditioning and enhancement of the road system and strengthening of the management of repair work in Hanoi's inner city in order to reduce dust pollution caused by traffic.
6. The reconditioning, repair and completion of Hanoi's sewage/drainage networks, with the following technical measures, shall be envisaged.

The option to be selected for ancient Hanoi shall be the integrated sewage/drainage system (industrial waste, domestic sewage and storm water); for the newly extended Hanoi the mixed system (with a half-separate system); and for the future extension of Hanoi the mixed system (with half-separate and separate systems). In the wet season, sewage/storm water shall be discharged mainly into the Nhue River (when the water level downstream of the Thanh Liet dam is below 4.5 m) and, in the dry season, into the Nhue River.

Hanoi is divided into three sewage areas:

- The area east of Road N° 1, consisting of the Set and Kim Nguu River Basin. A sluice gate serving the portion along the Kim Nguu and Set Rivers shall be constructed, as well as a sewage treatment station in Tran Phu Village.
- The To Lich and Lu River Basin: The self-cleaning process shall be used, with water from the West Lake to dilute sewage. Four small-scale sewage treatment stations shall be constructed to reduce pollution and to accelerate the self-cleaning process.
- The area of sand between the To Lich and Nhue Rivers: The half-separate sewage network and a pumping and treatment station shall be used in Me Tri, Dai Kim and Phu Do.

7. Additional underground pipes shall be installed along the ancient streets, and all double-vaulted and bucket latrines there shall be replaced by septitank latrines.
8. There shall be investment in the construction of a toxic waste treatment facility to handle industrial and solid waste from hospitals. Its capacity shall be approximately 20.000 tonnes/year.
9. All unused land in residential quarters, factory premises, along the road and sewage canal, etc. shall be dedicated to green space.
10. A monitoring system shall be established to collect environment-related data in all heavily polluted areas of Hanoi.

Conclusions

The research Thema KT .02.03 is large in terms of scale, scope and content. We believe this is the first time the present conditions and pollution impacts in the city of Hanoi have been evaluated on a comprehensive, objective, systematic and scientific basis. This important information will be of great use to environmental protection managers, designers, and urban planners. It is also hoped that these recommendations on measures to alleviate pollution and protect the environment will receive the attention of relevant local authorities, followed by their gradual implementation.

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Inventory of hazardous waste generation in India: a case study

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Abstract

To identify the main hazardous waste generators, and ascertain the quantity of various types of hazardous wastes, an inventory of hazardous waste generating industries has begun in India. This article presents the findings of such an inventory in the different districts of the state of Karnataka, in industrialized southern India. The information will be useful in preparing a hazardous waste management plan for Karnataka.

Résumé

En Inde, a débuté un inventaire des industries génératrices de déchets dangereux dans le but d'identifier les principales activités responsables et de déterminer les quantités de ces divers types de déchets. Cet article présente les résultats de cet inventaire dans les différents districts de l'Etat du Karnataka, situé dans le sud industrialisé de l'Inde. Ces informations seront utiles à l'élaboration d'un plan de gestion des déchets dangereux, pour le Karnataka.

Resumen

Con el fin de identificar los principales generadores de desechos tóxicos, y conocer los diferentes tipos de estos últimos, se ha iniciado un inventario de las industrias generadoras de desechos tóxicos en India. Este artículo presenta los hallazgos de tal inventario en los diferentes distritos del estado de Karnataka, en el sector industrializado del sur de India. La información puede ser útil en la preparación de un plan de gestión de los desechos tóxicos para Karnataka.

Background

The implementing arms of the Government of India, particularly the Pollution Control Boards, have been actively working with industry to control the quality and quantity of wastes from different industrial units.

The Water (Prevention and Control of Pollution) Act, 1974, and the Air (Prevention and Control of Pollution) Act, 1981, are oriented towards containment of pollutants from waste water discharges and air emissions, respectively, without putting emphasis on the ultimate disposal of pollutants removed by the treatment systems adopted. If sludges are formed during waste water treatment, these two Acts do not concern themselves with their disposal.

The Hazardous Waste (Management and Handling) Rules, 1989, under the Environmental (Protection) Act, 1986, were introduced against this background. They aim at providing control of the generation, collection, treatment, transport,

Table 1
Categories of hazardous wastes

Waste categories	Type of wastes	Regulatory quantities
No. 1	Cyanide wastes	1 kilogram per year (calculated as cyanide)
No. 2	Metal finishing wastes	10 kilograms per year (the sum of the specified substance calculated as pure metal)
No. 3	Waste containing water soluble chemical compounds of lead, copper, zinc, chromium, nickel, selenium, barium and antimony	10 kilograms per year (the sum of the specified substance calculated as pure metal)
No. 4	Mercury, arsenic, thallium and cadmium bearing waste	5 kilograms per year (the sum of the specified substance calculated as pure metal)
No. 5	Non-halogenated hydrocarbons including solvents	200 kilograms per year (calculated as non-halogenated hydrocarbons)
No. 6	Halogenated hydrocarbon including solvents	50 kilograms per year (calculated as non-halogenated hydrocarbons)
No. 7	Waste from paints, pigments, glue, varnish and printing	250 kilograms per year (calculated as oil or oil emulsions)
No. 8	Wastes from dyes and dye intermediates containing organic chemical compounds	200 kilograms per year (calculated as inorganic emulsions)
No. 9	Wastes from dyes and dye intermediates containing organic chemical compounds	50 kilograms per year (calculated as organic chemicals)
No. 10	Waste oil and emulsions	1000 kilograms per year (calculated as oil emulsions)
No. 11	Tarry wastes from refining and tar residues from distillation or pyrolytic treatment	200 kilograms per year (calculated as tar)
No. 12	Sludges arising from treatment of waste waters containing heavy metals, toxic organics, oils, emulsions and spent chemicals and incineration ash	Irrespective of quantity
No. 13	Phenols	5 kilograms per year (calculated as phenols)
No. 14	Asbestos	200 kilograms per year (calculated as asbestos)
No. 15	Wastes from manufacturing of pesticides herbicides and residues from pesticides and herbicides formulation units	200 kilograms per year (calculated as pesticides and their intermediate products)
No. 16	Acidic/alkaline/slurry wastes	200 kilograms per year (calculated as acids/alkalies)
No. 17	Off-specification and discarded products	Irrespective of any quantity
No. 18	Discarded containers and container liners of hazardous and toxic wastes	Irrespective of any quantity

Source: Gazette of India, Extraordinary, Part II, Section 3-Subsection (ii), 28 July, 1989

import, storage and disposal of hazardous wastes. Their principal objective is to establish a control mechanism for the management of hazardous wastes. The salient features of these rules are given below:

1. Eighteen categories of hazardous waste (Table 1) have been identified, along with regulatory quantities.
2. The generator must report the hazardous wastes being handled and apply to the State Pollution Control Board for handling authorization.
3. Wastes must be properly packaged, labelled and transported, in accordance with the Motor Vehicles Act (1988).
4. The generator must maintain records regarding handling and disposal practices and file an annual return. The generator must also report accidents to the State Pollution Control Board.
5. The State Pollution Control Board examines the applications for handling hazardous wastes and approves or denies authorization, as well as conducting periodic reviews of handling procedures.
6. The State Government maintains an inventory of hazardous wastes, makes environmental impact studies, and identifies sites for disposal of hazardous wastes.

In order to facilitate implementation of the rules relating to management and handling, a set of guidelines has been prepared which provides details for managing hazardous wastes from source of generation to final disposal. The guidelines are meant for:

1. the generator, with respect to the safe handling, storage, transportation, and disposal of hazardous wastes generated;
2. the transporter, with respect to the requisite safety requirements applicable during transportation of hazardous wastes;
3. the operator of the treatment and disposal facility, regarding the norms of operation of such a facility and for identification and assessment of hazardous waste sites;
4. the importer, with respect to the information and procedures required for review by the Central Government for importing hazardous wastes into the country.

In order to identify the major hazardous waste generators and hazardous waste quantity distribution in different State districts, an inventory of hazardous waste generating industries in various States of India has been initiated. This article presents the findings of such an inventory in one State, Karnataka, where the distribution of hazardous waste generating industries is not much different by and large from in other States. Karnataka is in the highly industrialized southern part of India (**Figure 1**). It has a total population of nearly 45 million and is divided into 20 Districts.

Table 2
Industry spectrum in the state of Karnataka

S.	Industry category	Number of industries			
		Large	Medium	Small	TOTAL
1.	Mining	10	6	33	49
2.	Metallurgy	14	40	302	356
3.	Chemicals (Including Fertiliser)	12	56	362	430
4.	Drugs and pharmaceuticals	4	29	60	93
5.	Leather and leather goods	1	6	31	38
6.	Pulp and paper	6	16	102	124
7.	Electroplating	-	1	91	92
8.	Engineering units	35	81	1,272	1,388
9.	Electronics	9	33	157	199
10.	Textiles (including silk)	28	33	3,343	3,404
11.	Electricals	11	33	164	208
12.	Printing units	13	12	774	799
13.	Power plants	2	1	90	93
14.	Lube oil refinery	4	12	48	64
15.	Pesticides	-	3	15	18
16.	Dyes and pigments (including inks)	-	4	63	67
17.	Rubber goods	3	15	123	141
18.	Asbestos	1	-	3	4
19.	Automotive workshops	5	2	147	154
20.	Soaps, detergents and cosmetics	1	6	29	36
21.	Vegetable oils and vanaspati	9	38	652	699
22.	Timber products	4	10	1,237	1,251
23.	Sugar	32	7	24	63
24.	Fermentation (distillery/brewery)	3	14	43	60
25.	Cement	16	21	67	104
26.	Ceramics and glass	2	12	329	343
27.	Plastics	3	18	140	161
28.	Food processing	8	78	1,632	1,718
29.	Others	5	21	626	652
	Total	241	608	11,959	12,808

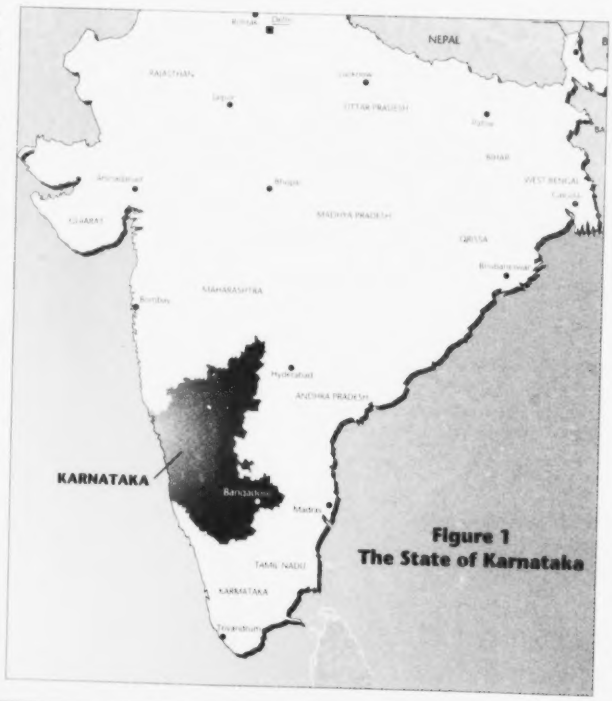


Figure 1
The State of Karnataka

Industry profile

The State of Karnataka, which is rich in mineral resources, is experiencing substantial mining activity and the growth of related metallurgical industries. Industries (hazardous and non-hazardous waste generators) are heavily concentrated in specific pockets. Bangalore, the State Capital, where 14 per cent of the population lives, accounts for 37 per cent of large/medium industries and 41 per cent of all industries (including small-scale). An overview of the industry spectrum is provided in **Table 2**. A number of large industries, including those involved in the production of gold, aluminium, fertilizer, pulp and paper, textiles and chlor-alkali, as well as automotive engineering industries, is located in Karnataka.

Hazardous waste generation in large and medium industries

The assessment of hazardous waste generation was carried out within the framework of the Hazardous Waste (Management and Handling)

Figure 2
Districtwise generators of hazardous waste in large and medium industries in Karnataka

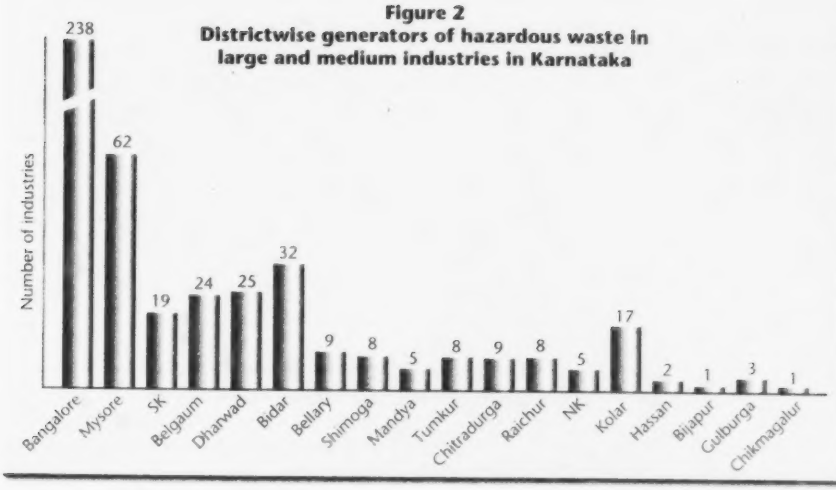
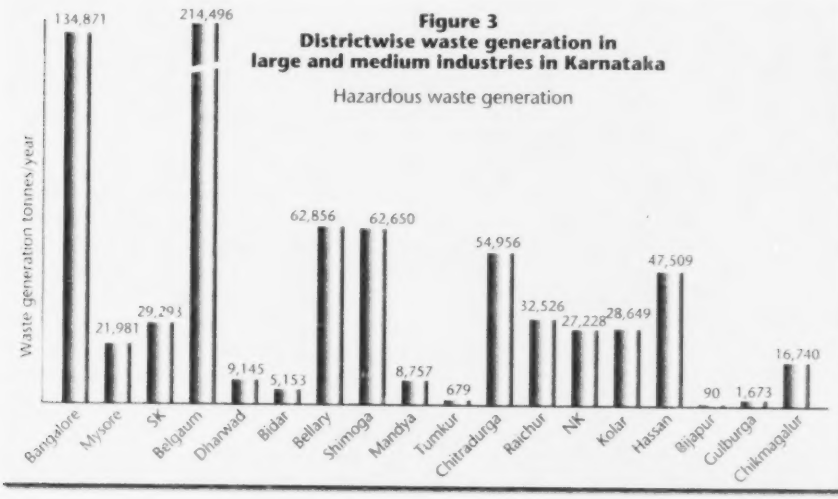


Figure 3
Districtwise waste generation in large and medium industries in Karnataka



Rules, 1989. The first step was to gather data on the kinds of industries located in Karnataka, the types of products manufactured, the raw materials used, and total waste generated. The data available from different agencies were collected.

After a detailed perusal of information, the industrial spectrum in Karnataka was divided into 29 categories (hazardous and non-hazardous waste generator) (Table 2). Nineteen categories of significant hazardous waste generating industries were identified (**Table 3**). Electroplating units, which are a major hazardous waste source, were included with the large/medium industries for assessment.

The process flowlines of the industries were discussed with concerned industry experts. Waste generation norms were laid down for each industry and applied to assess the wastes generated. The norms were further checked through personal visits to a sample of industries in the same industrial segments. The waste quantities were then aggregated and analysed by district and industry.

An assessment of waste water generation was made in all cases to obtain an idea of total generation of wastes *vis-à-vis* the generation of hazardous substances which need treatment. In waste water treatment many hazardous substances are concentrated in the sludge. An estimation has been made of the sludge likely to be formed, which is considered as semi-solid waste. Various other hazardous wastes, such as brine mud, red mud, and all sludges have been classified as semi-solid.

An overview of waste generation

On the basis of the number of hazardous waste generators identified, the total generation of wastes in Karnataka is on the order of 3,90,387 tonnes per year (Table 3). They could be classified broadly as follows:

- tailings from gold mining (57,718 tonnes)
- tailings from copper mining (95,000 tonnes)
- slag from metallurgical units (26,102 tonnes)
- others (11,567 tonnes)

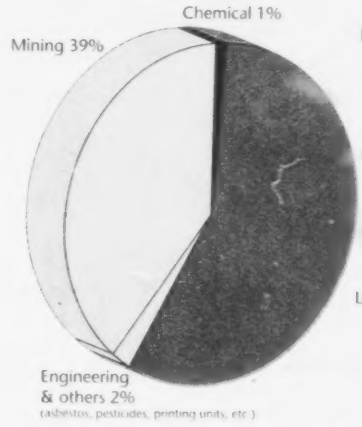
Tailings from gold mining are very hazardous, whereas those from copper mining are considered to pose a lower level hazard. These categories of waste are found at two locations in Karnataka. Metallurgical wastes are found at twelve locations. The balance of 11,567 tonnes from other industrial sectors is spread throughout the State.

The total quantity of semi-solid wastes is 3,68,765 tonnes/year (Table 3). The study indicates that the bulk is "red mud" (2,10,690 tonnes/year). It is generated at one location in Karnataka.

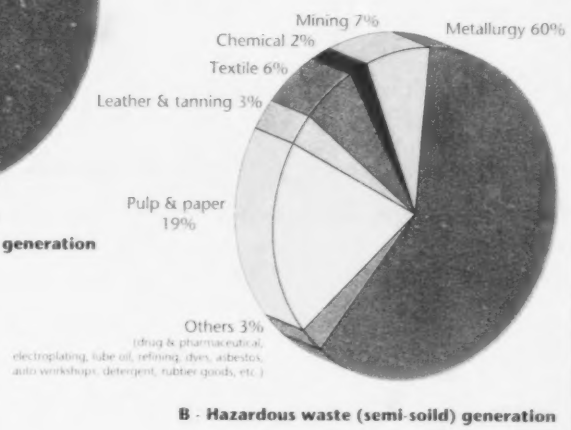
The 1,58,075 tonnes of semi-solid wastes is spread over all industry groups. However, with a few exceptions such as brine mud in a chlor-alkali plant, it largely consists of sludges from waste water treatment plants.

The percentage distribution of hazardous solid and semi-solid wastes from different groups of industries in Karnataka State as a whole is shown in **Figure 2**. Based on information concerning waste loads in each district, the potential sites for disposal of hazardous wastes have been identified by the State Government/State Regulatory Body.

Figure 4
Hazardous waste generation in Karnataka



A - Hazardous waste (soild) generation


Mining 7%
Metallurgy 60%
Chemical 2%
Textile 6%
Leather & tanning 3%
Pulp & paper 19%
Others 3%
(drug & pharmaceutical, electroplating, lube oil, refining, dyes, asbestos, auto workshops, detergent, rubber goods, etc.)

B - Hazardous waste (semi-soild) generation

Table 3
Industry category-wise distribution of waste generation

Industry category	Units	Waste generation			
		Solid (t/yr)	Semi-solid (t/yr)	Liquid (kl/yr)	Waste category number
1. Mining	5	1,52,718	25,289	25,64,859	1,3,12
2. Metallurgy	56	2,26,102	2,23,349	12,74,918	3,6,12
3. Chemicals	47	4,301	9,555	14,08,503	12,3,4, 16,8,1, 6,5, 9,10
4. Drugs and Pharmaceuticals	39	-	2,620	3,10,670	5,3, 12,16
5. Leather	5	-	9,452	3,17,360	3,12,8
6. Pulp and paper	20	-	70,760	90,770	6
7. Electroplating	92	-	36	1,09,080	1,6
8. Engineering units	89	-	6,477	2,033	10,15,9,7,6
9. Electronics	12	-	144	1,45,560	1,12,7
10. Electrical	16	381	1,948	1,99,908	3,12,1, 5,11
11. Textiles	31	-	21,304	2,25,14,320	8
12. Printing units	26	63	-	974	6,7
13. Lube oil refinery	9	-	1,080	-	11
14. Pesticides	3	50	3	306	15
15. Dyes	4	-	159	15,840	8
16. Rubber goods	11	-	968	96,840	12
17. Asbestos	1	280	43	-	14
18. Automotive	7	-	3	7,560	1,6
19. Soaps/detergents	2	12	8	1,620	5
Total	**475**	**3,90,387**	**3,68,765**	**3,00,75,064**	

Figure 5
Frequency distribution of occurrence of hazardous waste category in different districts of Karnataka

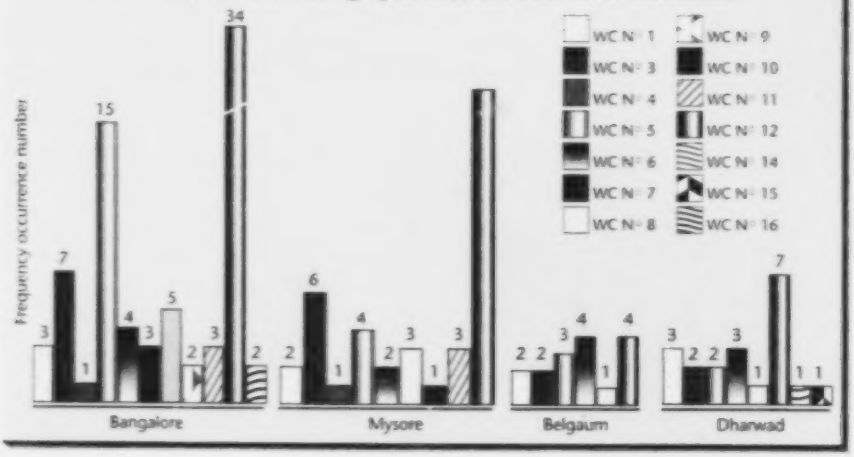


Table 4
Industrial category-wise waste generation in small-scale units

Industry category	Units	Solid (t/yr)	Semi-solid (t/yr)	Liquid (kl/yr)
1. Chemicals	369			66,420
2. Textiles	340			61,200
3. Pesticides	15	1.5		2,700
4. Dyes	63			11,340
5. Tanning	10		5,400	1,80,000
Total	**797**	**1.5**	**5,400**	**3,21,660**

Hazardous waste generation in small-scale industries

Among small-scale industries, chemicals, textiles, dyes/pigments, pesticides and leather tanning were selected as potential hazardous waste (**Table 4**) generators. Solid hazardous waste generation was estimated to be about 1.5 tonnes/year, in the form of dust fines and sweepings from the pesticides industry. The amount of semi-solid waste estimated was about 5,400 tonnes/year from ten tanning units located in Bangalore.

Conclusion

This article provides an account of a study carried out to identify hazardous waste generating industries and to obtain a quantitative distribution of hazardous waste by industries in the different districts of the State of Karnataka. The major contribution of hazardous wastes is from mining and metallurgical operations. Waste category number 12 (sludges) is the most frequent type of hazardous waste in almost all the Districts. The estimated quantities of solid hazardous waste suitable for disposal on land and for incineration are 7,46,000 tonnes/year and 7,000 tonnes/year, respectively. The major proportion, about 6,27,487 tonnes/year or 84 per cent, of the total waste considered suitable for landfill is generated through mining and metallurgical operations. Incinerable wastes are mainly from drugs and pharmaceuticals, lube oil, pesticides, and chemical processing units. The State Government, depending on the industrial location and environmental considerations, has identified five landfill sites and five incinerators for conducting detailed Environmental Impact Assessment (EIA) and design of landfill and other treatment options. The information on volume and category of hazardous wastes will be useful for preparation of a hazardous waste management plan for the State of Karnataka, including provision of treatment facilities for different qualities and quantities of hazardous waste and the development of secured landfills and incinerators. ◆

Tourism Focus

A regular section reporting on developments in the field of sustainable tourism, and on the activities of the UNEP Tourism Programme

N° 7

The environmental programme of British Airways Holidays

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Abstract

British Airways was one of the first major UK tour operators to adopt an environmental policy and associated programme of action. Based on the results of an environmental review and a destination audit, British Airways Holidays has implemented a series of initiatives ranging from Traveller Donation Schemes, and Eco Notes for customers, to the British Airways Tourism for Tomorrow Awards. The objectives of these actions are to encourage staff to include environmental considerations in daily decision making, increase customers' environmental awareness and encourage them to adopt environmentally sensitive practices, and influence the behaviour of suppliers.

Résumé

British Airways est l'un des premiers voyagistes britanniques qui ait adopté une politique sur l'environnement et entamé un programme d'action. A l'issue d'un tour d'horizon de l'environnement et d'une enquête sur les destinations de prédilection des vacanciers, British Airways Holidays a mis en oeuvre une série d'initiatives allant de Programmes de Dons des Voyageurs à des Bulletins Verts à la clientèle, en passant par un Trophée British Airways pour le Tourisme de Demain. Ces initiatives ont pour but d'encourager le personnel à tenir compte de facteurs écologiques dans leur prise de décision quotidienne, de responsabiliser la clientèle vis-à-vis de l'environnement en l'incitant à adopter des pratiques écologiquement saines et d'influencer le comportement des fournisseurs.

Resumen

British Airways fue una de los primeros operadores de giras británicos en adoptar una política medioambiental y comenzar un programa de acción. Basado en los resultados de un análisis medioambiental y una auditoria de destinación, British Airways Holidays ha puesto en marcha una serie de iniciativas que van de Esquemas de donación viajero?, Eco-Notas para los clientes, al Turismo British Airways para los Premios del Mañana. Los objetivos de estas acciones son estimular al equipo para incluir consideraciones medioambientales en la toma diaria de decisiones, para aumentar la conciencia medioambiental en los clientes y a estimularlos a adoptar prácticas ambientalmente sensibles, e influenciar el comportamiento de proveedores.

British Airways Holidays is the wholly-owned tour-operating subsidiary of British Airways. With headquarters in the United Kingdom and representation in British Airways offices around the world, British Airways Holidays sells vacations both from and to the UK. The overseas offices, in 77 countries, sell inbound travel to the UK and elsewhere through over 40 brochures in 17 languages. British Airways Holidays employs over 500 people.

The company recently launched eight outbound brochures for 1997: Golf and Sport, Cruise and Stay, Worldwide, Far East, Caribbean, South Africa, America & Canada, and Florida, creating over 200,000 holidays in 60 countries – 25 per cent more than last year. New destinations include Vietnam, Bintan in Indonesia, Namibia and Zambia and new activities include scuba diving. Golf and scuba diving present special environmental problems of their own.

Launching the 1997 product, Managing Director Roger Heape told the media: "The trend for holidays to far-flung destinations is still on the up. Long-haul holidays now account for 20 per cent of the total UK holiday market and are the fastest-growing part of the market."

Over 50 per cent of long-haul holidays are taken by the over-45s. This age group will increase in size from 22.5 million people in 1995 to 24.5 million by 2005. As a result there will be an extra two million experienced travellers looking for new long-haul places to visit.

Foreign travel is also expanding rapidly outside the UK, particularly in the touristic economies of the Far East. Although initially travel was to places close to home, travel on a much wider scale is likely to grow exponentially.

All of these developments indicate a huge increase in global tourism over the next 10 years. This inevitably means massive hotel-building programmes which are bound to have some impact on the environment. It is no use pretending there will be no impact – the challenge is to minimize the environmental impact of these developments.

Review, policy and goals

British Airways Holidays was one of the first major UK tour operators to introduce an environmental policy and an associated programme of action. The British Airways Environment Branch conducts a rolling programme of reviews covering the environmental aspects of the airline's activities at all major locations. In 1993 British Airways Holidays, assisted by an environmental consulatancy firm, became the first subsidiary company to conduct an environmental review of its internal and external affairs. The review concentrated on activities managed by British Airways Holidays and focused on both the outbound and inbound aspects of its operations. The review included general housekeeping issues but was not designed to cover the detailed impact of tourism on all the resorts in its brochures.

Information was acquired by the environmental consultancy team and the British Airways Environment Branch by means of interviews and site visits and a survey of employees, competitors, industry associations, and non-government organisations concerned with tourism and the environment.

Following the review, British Airways Holidays appointed an Environmental Coordinator, reporting to the Managing Director, to champion environmental issues, provide a focus for activity, liaise with external organisations, and monitor implementation. It also made a policy statement, developed from the airline's environmental policy, to reflect the particular nature of British Airways Holidays business. This pledged to:

- promote policies and actions that will benefit the environment and inspire the confidence of customers, employees and suppliers;
- develop awareness and understanding of the interactions between the company's operations and the environment;
- maintain a healthy working environment for all employees;
- consider and respect the environment and seek to protect it in the course of company activity.

The company went on to say that it would achieve these goals by:

- taking account of environmental issues in its commercial decision making, including negotiations with suppliers;
- working constructively with organisations who are concerned for the environment;
- promoting its environmental activities to staff and customers through its brochures, documentation and other communications;
- observing laws and guidelines aimed at protecting the environment;
- providing support and advice on environmental matters relating to operations, including customers;
- using natural resources efficiently.

Reaching the customer

While the company was able to introduce good environmental practices within its own operations it also wanted to reach a wider audience, especially its customers and suppliers, through persuasion, education and example.

There is considerable debate on environmental issues relating to the travel and tourism industry, and scientific and sociological research and intellectual argument. Little of it reaches the non-specialist or the paying customer in a form that encourages understanding, support, participation or initiative.

British Airways Holidays, while taking scientific and professional advice, conducting research and contributing to the wider debate, wanted to introduce clear-cut ideas and initiatives that could be communicated easily and would gain the attention and approval of customers and influence the behaviour of suppliers.

Communicating effectively with customers and suppliers presented a considerable challenge. Customers spend significant amounts of money on the year's main vacation and could not be expected to respond well to complex environmental messages at the very moment they were planning to relax and enjoy themselves. Suppliers had their own cultures, objectives and commercial imperative and were often operating overseas in very different economic and political circumstances. Any awareness programme had therefore to be sympathetic to the mood of the audience.

Fragile Earth

Wherever you go be a friend to the environment

Thailand

India

Kenya

Brazil

South Africa

Travel wisely:-

When British Airways Holidays activated its environmental programme in 1993 it embarked on a series of initiatives designed to help it meet these criteria. In summary, it set out to:

- encourage staff at all levels to bring environmental considerations into their business activities so that day-to-day decision-making would have an environmental component alongside other operational and corporate criteria;
- encourage customers to reduce waste and use less energy and water and inform them about the more vulnerable aspects of the environments they are travelling in;
- motivate customers to set their own standards and believe their behaviour makes a difference, and encourage them to support conservation work and to speak out when they come across bad practice;
- give customers information about what the company is doing under its environment programme;
- give customers relevant environmental information about their destination;
- ask hoteliers and other suppliers to carry out environmental audits and introduce good practice.

Destination audit

British Airways Holidays wanted to know about the long-term viability of stressed destinations if they continued to receive increasing numbers of tourists – information that could have key planning and commercial significance. It also believed, as an industry leader, that if the company and its staff were well informed they could act more responsibly and develop an enlightened position on environmental issues relating to tourism wherever they arose. Traditionally, tourism developers and operators have tended to abdicate responsibility for the environmental impacts of tourism. The ultimate responsibility, they suggest, lies with the host countries and resorts.

Increasingly, however, there is recognition that, like other industries, tourism will have to accept "cradle to grave" life cycle responsibility and practise a greater degree of environmental stewardship. But, given that tour operators, British Airways Holidays among them, are responsible for packaging many disparate elements into a holiday product, the challenges they face are wide-ranging and many.

Although British Airways Holidays did not set out to measure environmental impacts in all its destinations, one of the recommendations of the environmental review was that the company should undertake a survey of the impacts of its products on one specific destination. The UK Centre for Economic and Environmental Development was commissioned to carry out this work, and the Seychelles was chosen for the survey because of its popularity as a holiday destination and because of its clearly defined geographical boundaries.

The report was completed in 1994 and identified a number of areas, including tourism infrastructure, consumption of resources, and material and waste management, for cooperation and improvement. The study produced a matrix of environmental impacts and an environmental destination fact sheet for the Seychelles. Among the potential issues identified were:

- water pollution as a consequence of inadequate sewage systems;
- wastes generated from products ranging from food to cars imported to support tourism;
- exploitation of endangered species for souvenirs.

In overall terms the audit provided valuable information about the short and long-term effects of large-scale tourism and gave British Airways Holidays an insight into and an awareness of the sort of problems local communities and travel operators could be facing before long.

Key activities
As it approaches the fourth anniversary of its environmental review, British Airways has implemented a number of key initiatives. With new products in development and with some holiday activities having the potential to put pressure on local ecosystems, the company is keen that its environmental policy should evolve to meet the future needs of the industry and its customers. It is therefore committed to developing new initiatives and placing environmental considerations at the heart of its business life. Among those currently on stream are:

Awareness Seminars
British Airways Holidays has held environmental seminars for staff creating awareness of the company's policies and activities and raising day-to-day awareness of environmental considerations.

Environment Team
A head office voluntary group which monitors energy consumption and implements recycling schemes and campaigns on such diverse issues as car-sharing and the use of china coffee mugs instead of disposable plastic cups.

Fragile Earth
The outbound British Airways Holidays brochures carry a Fragile Earth panel. These carry general information about the company's environmental policy, general environmental guidelines, information about the Traveller Donation Scheme, and postal and E-mail addresses for the company's Environmental Coordinator. An example, prepared for the 1997 outbound Worldwide brochure, is reproduced here.

Traveller Donation Scheme
British Airways Holidays supports conservation work in several countries through its Traveller Donation Scheme. For every customer travelling to the country concerned, British Airways Holidays donates to the conservation organisation. Those who are benefiting this year include The Tiger Trust's work in Thailand, International Trust for Nature Conservation in India, Friends of Conservation in Kenya, Survival International in Brazil, Earthwatch in Florida and California, and the Venice in Peril Fund. The company is also planning to contribute to a proposed South African project. Information about the Traveller Donation Scheme and its beneficiaries is carried in the Fragile Earth panel in the appropriate holiday brochure.

Travel advice and information booklet
All customers receive a copy of British Airways Holidays Travel Advice and Information booklet which contains general advice for travellers and covers topics such as baggage allowances and check-in procedures, visa requirements and so on. It also carries a section on environmental issues and gives advice intended to enhance customers' enjoyment of their holiday. For example, it suggests travellers remove the packaging from their films, cosmetics and other holiday items before they travel, pointing out that this makes their baggage lighter, burns less aircraft fuel, and lessens the load on the garbage disposal system at their destination. There is also advice on energy saving in hotels and a demand that customers do not attempt to purchase and return to the UK with products made from threatened or endangered species.

Eco notes
All customers also receive a set of Holiday Notes giving destination-specific information on such matters as climate, voltage, and travel from airport to hotel. These notes also contain destination-specific Eco Notes. These give customers information about the host government's position on environmental issues and whether the country has an environment policy, important cultural factors, differences they will encounter, rare and endangered species, heritage sites and national parks, local concerns and initiatives and how to give feedback or seek more information. These notes are updated annually.

It is interesting that when the notes were first begun, in 1994-95, few government offices or tourist boards were able to supply any environmental information at all – apparently nobody had asked for it before. At the time of the first annual update, tourist boards and other organisations were sent copies of the Eco Notes pertaining to their country but only a handful responded.

Tourism for Tomorrow
British Airways Tourism for Tomorrow Awards recognise environmental achievement around the world. This year's awards will, for the first time, include a British Airways Holidays Special Award to encourage and acknowledge the hotel supplier with the best environmental programme.

Customer response
Customer Satisfaction Questionnaires, distributed to all customers, include a panel of environmental questions to ascertain customer attitudes. Recent response has been very positive, with 98 per cent of customers expressing concern about environmental issues and over 87 per cent saying they would prefer to travel to a destination with a good environmental record. Recent research carried out by British Airways among leisure travellers showed that, all other things being equal, 53 per cent would select an airline or tour operator which took environmental considerations into account.

Lobbying
When appropriate, the company has made direct representation to international organisations and ministers and officials of destination countries, urging them to implement conservation measures, protect certain species, or refrain from resuming activities harmful to wildlife.

Future plans
The company acknowledges that it takes time to change and significantly improve environmental practices if there is not an obvious, immediate and urgent market demand. The intention is to continue working on existing projects and developments while also focusing on suppliers and communicating the expectations the company has of them.

Only when tour operators, destinations and suppliers commit to a code of environmental practice and conduct will environmentally sensitive tourism become a marketing benefit actively sought by by the majority of customers.

A further destination audit is planned for 1996-97 in cooperation with the government of St Lucia.

Contact: E-mail: 100615.1171@compuserve. com.

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TOURISM NEWS

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Environment and golf

A series of four seminars on environmental management of golf courses was organized by the European Golf Association (EGA) Ecology Unit on the occasion of the visit to Europe by Audubon International. Audubon International operate the Audubon Cooperative Sanctuary System, a voluntary environmental certification programme for golf courses, businesses, backyards and schools. For more information contact:

European Golf Association Ecology Unit, c/o Environmental Golf Services, 51 South Street, Dorking, Surrey RH4 2JX, UK. Fax: +44 1306 74 24 96

The World Association for Professional Training in Tourism (WAPTT) Congress

The biannual Congress/General Assembly of the World Association for Professional Training in ■■

Tourism (WAPTT) was held in San José, Costa Rica, 27 to 31 October 1996. The conference theme was "Tourism in Support of Nature, Towards Creating a Collective Consciousness". UNEP IE made a presentation on "Cleaner Production in the Tourism Industry, the Important Role of Educators".

Council of Europe Seminar

A seminar on "Tourism and Environment, Towards a New Tourist Culture" was organized by the Council of Europe on 21-23 November 1996. UNEP IE made a presentation on "Cleaner Production in Tourism: From Theory to Practice". For more information contact:
The Council of Europe, Directorate of Local Authorities, Environmental Conservation and Management Division, F-67075, Strasbourg Cedex, France.

ACOPS's Workshop on the Sustainable Development of Tourism in the Eastern African Region

A workshop on the "Sustainable Development of Tourism in the Eastern African Region" took place on 20-22 October 1996 in the Seychelles, organized by the Advisory Committee on Protection of the Sea (ACOPS). UNEP IE made a presentation on "Challenges for Sustainable Tourism", the Role of the Partners and Stakeholders". A portfolio of sustainable tourism projects was presented by countries from the region. For more information contact:
ACOPS, 11 Darmouth Street, London SW1H 9BN, United Kingdom. Fax: + 44 171 799 2933

Africa Travel Association Ecotourism symposium

The Africa Travel Association's third biannual Ecotourism Symposium was held 17-21 November 1996 in Marrakech, Morocco. UNEP IE made a presentation on "Environmentally Sensitive Tourism, the Role of Tour Operators and Travel Agents". For more information contact:
Africa Travel Association, 347 Fifth Avenue, Suite 610, New York, NY 100 16, USA. Fax: +1 212 725 8253

Tourism and the Environment Think-Tank

In preparation for the upcoming RIO+5 conference, the World Travel and Tourism Council, the World Tourism Organization and the Earth Council organized a tourism and environmental think-tank to discuss the implementation of Agenda 21 in the tourism industry. For more information contact:
World Travel and Tourism Council, Chaussée de La Hulpe 181, Box 10, 1170 Brussels, Belgium. Fax: +32 (2) 660 91 70.

PUBLICATIONS

Awards for Improving the Coastal Environment: the Example of the Blue Flag

"Awards for Improving the Coastal Environment: the Example of the Blue Flag" is a joint UNEP/World Tourism Organization/Foundation for Environmental Education in Europe publication.

There is an urgent need to better integrate the many uses of coastal resources, and this publication describes how tourism can be better integrated into coastal zone management through an award scheme, the European Blue Flag.

The first part of the publication deals with the development of the Blue Flag, the range of criteria to be fulfilled such as water quality, cleanliness, safety and management of beaches, information and education, and the operation of the scheme. Examples of national initiatives are used to demonstrate how the campaign is being applied to better respond to country-specific needs and priorities.

The second part of the publication discusses the lessons learnt from the European Blue Flag scheme, and highlights the problems likely to be encountered and the steps to establish successful coastal environmental improvement award campaigns in non-European regions.

Environmental Good Practice in Hotels

"Environmental Good Practice in Hotels", published by UNEP IE and the International Hotel & Restaurant Association (IH&RA), presents 15 case studies selected from the IH&RA annual Environmental Award.

The case studies present the environmental programmes of 15 hotels across the globe, in Australia, Africa, Europe and North America. The action areas include environmental policy, design and construction, water, energy, waste, emissions, purchasing, staff training, and guest communication.

The range of environmental initiatives featured is extensive, from simple recycling measures to water conservation using the latest technology, and from resorts built to strict environmental guidelines to small country hotels where environmental activities are driven by the personal commitment of the general manager. All case studies highlight the environmental and economic benefits gained by the actions taken.

Examples of environmental initiatives taken by national hotel associations and a list of sources for environmental management publications and programmes are also included.

Tourism Focus

Offprints of Tourism Focus published to date are now available:
Tourism Focus 1: Australia's National Ecotourism Strategy
Tourism Focus 2: Tampere Hall: An Environmentally Conscious Congress Venue in Finland
Tourism Focus 3: Sustainable Tourism in Nepal's Royal Chitwan National Park
Tourism Focus 4: Towards a Pan-European Environmental Management Programme for Golf
Tourism Focus 5: Environmental Reviewing for the Hotel Sector: the Experience of Inter-Continental Hotels and Resorts
Tourism Focus 6: The Forests of Tierra Del Fuego: the Need to Support Sustainable Ecotourism.

Tourism and the Natural Environment: Overview of Organizations

The Netherlands Ministry of Agriculture, Nature Management and Fisheries, Department of Outdoor Recreation has published a list of over 40 international, governmental or non governmental organizations, working on tourism and the environment, all over the world. For more information contact:
Recreation Foundation, Post-box 80547, 2508 GM Den Haag, The Netherlands. ◆

World News

A Green Paper from the European Commission to stimulate debate on noise pollution

The European Commission has published a Green Paper entitled *Future Noise Policy*, which it hopes will launch a wide-ranging debate on the subject. Although many Europeans consider noise from traffic and industrial and recreational activities to be their main local environmental problem, noise has generally had a lower priority than problems such as water and air pollution. The Green Paper is intended to be a first step in the process of developing an abatement programme.

Recent studies have shown that as much as 22 per cent of the European Union's population – around 80 million people – are exposed to outdoor noise levels from transport in excess of 65 dB(A), the level generally considered acceptable. Another 170 million are exposed to 55-65 dB(A), levels generally thought to provoke serious annoyance in daytime. The dominant source, accounting for nine-tenths of exposure to levels above 65 dB(A), is road transport. Rail transport accounts for exposure of 1.7 per cent of the population and air transport for exposure of 1 per cent.

Action within the European Union to date has mainly consisted in fixing maximum levels for vehicles, aircraft or machines. There has nevertheless been significant progress, with noise from individual cars being reduced by 85 per cent since 1970 and noise from lorries by 90 per cent. Modern jet aircraft produce around nine times less noise than those built in the 1970s. However, data for the last 15 years indicate that these technological advances have been largely offset by the expansion of traffic in rural and suburban areas and the length of time annoying levels of noise are present in a 24-hour period due to increased night-time use of roads.

Forecasts show that, if abatement policies are not developed and implemented, many people will continue to be exposed to unsatisfactory noise levels and the situation may well deteriorate. Major trends influencing the current and future situations are:

- increases in road freight transport, which is likely to almost double (in tonnes/km) by the year 2010, and in air traffic, which is expected to increase by 180 per cent;
- the development of high-speed rail;
- the spatial spread of traffic noise to affect rural and suburban areas;
- the temporal spread of noise as 24-hour freight distribution increases.

Noise is essentially a local problem, which means that development and implementation of solutions are local responsibilities. However, the root causes of noise are often diverse rather than local. For instance, increased international demand for transport, causing increased use of airports, is an example of an international phenomenon with local effects. Finding overall solutions therefore requires a sharing of responsibility. All the actors should work towards a common goal. The Green Paper points out that, due to the absence of an overall noise abatement programme, this approach has been lacking at the European Union level. Future actions, the Green Paper suggests, should include the establishment of common noise assessment methods and common exposure indices as necessary steps towards improving the present situation.

For more information, contact: The European Commission, Directorate General for Environment, Nuclear Safety and Civil Protection, "Green Paper on Future Noise Policy", Rue de la Loi/Wetstraat 200, B-1049 Brussels, Belgium. ◆

Asian Productivity Organization – World Conference on Green Productivity

The rapid development of the Asia-Pacific region in recent years (which is expected to continue into the 21st century) has not been without adverse consequences for the environment. It has improved the living conditions of the majority of the region's population, but has also contributed to problems such as air and water pollution, production of hazardous waste, and global warming. In recognition of this situation, the Asian Productivity Organization (APO) organized the World Conference on Green Productivity, held on 4-6 December 1996 in Manila, the Philippines. Adopting the green productivity concept means adopting a new paradigm, in which the relationship between improved productivity and environmental preservation is no longer perceived as a trade-off but as a harmonious relationship in which protecting the environment is seen as integral to improving productivity.

APO believes that the most effective way to encourage green productivity is through a "micro to macro" approach. This means instituting cleaner production systems as part of the process of increasing productivity at individual production sites as well as encouraging their spread to other sites and, ultimately, to industry as a whole.

Since its inception in 1961, APO has been involved in a wide range of programmes focusing on productivity improvement at the micro level, working in close cooperation with the National Production Organizations (NPO) in member countries. As part of these activities, APO has set up the Special Program for Environment (SPE), funded by the Japanese government. The World Conference on Green Productivity was one of the major events organized under the auspices of the SPE.

UNEP was pleased to take part in the conference. Further cooperation will be developed between UNEP's Industry and Environment centre and APO, in order to link their cleaner production and green productivity approaches.

For more information, contact: Asian Productivity Organization, 4-14 Akasaka 8-chome, Minato-ku, Tokyo 107, Japan. Tel: +81 (3) 3408 7221, Fax: +81 (3) 3408 7220. ◆

Environmental Performance Review of Austria

As part of its environmental review programme, begun in 1991, the OECD has produced a review of Austria which examines results to date in the light of domestic objectives and international commitments in regard to environmental issues.

The need to protect the environment was recognized in Austria by the early 1970s. More recently, awareness has been heightened by the importance of tourism in the economy and by pressure from other sectors such as transport, energy, industry and agriculture. Overall, Austria has been very successful in dealing with the major environmental issues of the 1970s: sulphur dioxide (SO_x) emissions have been reduced by 82 per cent since 1980, those of nitrogen oxides (NO_x) by 20 per cent, and those of carbon monoxide (CO) by 15 per cent. Emissions of carbon dioxide (CO_2) (59.2 million tonnes in 1992) remained stable throughout the 1980s, increased sharply between 1988 and 1991, then dropped in 1992. Per unit of GDP, Austrian emissions of CO_2 from energy use are around 20 per cent lower than the OECD average. However, the country's land-locked position in central Europe (Austria has borders with eight other countries) and its location across important north-south and increasingly important east-west transport routes, gives rise to some specific environmental problems. The quality of Austria's environment is partly dependent on progress made by its neighbours. As can be seen from **Table 1**, the country is at present a net "importer" of transboundary air pollution, especially of SO_x and NO_x from Germany, the Czech Republic, Slovakia, Poland, Hungary and Italy.

In 1989, 70 million tonnes of freight passed through Austria. It is expected that transit freight traffic could grow as much as 165 per cent by the year 2000. Eighty-five per cent of this freight traffic is made up of foreign trucks on the Ger-

Table 1
Import and export of pollutants, Austria 1992

	SO_x (ktonnes sulphur)		NO_x (ktonnes nitrogen)		NH_3/NH_4 (ktonnes nitrogen)	
	Import[a]	Export	Import[a]	Export	Import[a]	Export
Germany	23.7	1.5	18.6	2.3	15.2	3.6
Czech Republic and Slovakia	16.6	2.1	4.2	2.6	4.0	4.9
Poland	6.9	0.9	1.8	1.8	1.2	1.4
Hungary	4.7	1.5	1.9	0.6	2.3	1.7
Slovenia	5.7	0.8	0.4	0.8	0.9	1.6
Italy	21.8	1.2	11.7	1.7	8.4	1.7
Switzerland	1.4	0.3	0.3	2.2	2.5	0.4
Other	-	-	-	-	-	-
Total	121.5	16.1	67.8	27.4	49.8	26.5
Deposition in Austria due to emissions in Austria		9.5		3.2		39.7

a) Deposition in Austria due to emissions abroad
Source: UBA

Table 2
Indicators of tourism intensity

	Austria	Tyrol	Salzburg	Carinthia
Maximum population density:[a]				
Including overnight tourists	263	538	388	295
Including overnight and day-trip tourists	304	713	496	326
Overnight stays in 1993				
Million persons	127.0	44.6	24.8	16.6
Per inhabitant	17	72	50	33
Secondary residences as % of total residences	4.7	4.2	5.7	5.0
Capacity of cable-cars and lifts in person-vertical metres per hour	8700	24,000	25,300	6000

a) Persons per km² of permanent built-up land during the most frequented month of the year
Source: Institute for Spatial Planning, Chamber of Commerce

many-Brenner-Italy route. Concern over this issue led to public protests and the setting up of road blocks towards the end of the 1980s. To address the problem, Austria decided in 1989 to restrict night driving on all transit routes to low-noise vehicles, at a maximum speed of 60 km/hour. An important campaign was also launched to promote the attractiveness of rail transport, with the intention of attracting eastern traffic. An agreement reached with the European Union in 1991 aims to reduce emissions from goods vehicles by 60 per cent by 2003. This agreement, which came into force in 1993, limits transit freight traffic by road to 108 per cent of the 1991 level and restricts maximum vehicle size to 38 tonnes. Austria has also provided technical assistance to its eastern neighbours to improve vehicle standards and railway systems, as part of more general aid for the construction of new highways and improvements in railway infrastructure in the east.

Austria has a permanent population of 7.9 million inhabitants, mostly living in the Alpine valleys and in the east, to which must be added an additional "population" of almost 25 million tourists (number of arrivals registered in 1993) from other countries, mainly Germany. As illustrated by **Table 2**, visits are concentrated in specific areas and periods. Summer and winter tourism, representing around 15 per cent of GDP, has a significant impact on the environment. Tourism creates environmental pressure in a variety of ways, mainly: traffic-related pollution; land use, often in ecologically sensitive areas; damage to fauna and flora; pressure on water quality, especially in ecologically sensitive Alpine areas; and generation of waste, particularly difficult to dispose of at high-altitude resorts. Until the late 1970s, policy on tourism favoured expanded land use for the purpose. It was then increasingly realized that overexploitation of the environment can rapidly erode tourism's economic basis. This became clear when, for example, the deteriorating quality of Austria's lakes led to a rapid decline in tourism.

The fundamental importance of environmental protection for tourism is now clearly understood and incorporated into policy at both national and provincial levels. This is evidenced by the inclusion in the National Environmental Plan (NUP), developed in 1994, of a special section devoted to tourism based on the notion of its sustainable development. At the provincial level more specific objectives are fixed, including moratoria on further expansion of tourism in high-intensity areas, increased use of public transport by tourists, and targets for expansion of national parks.

Austria is a federal state in which government responsibilities are shared by three levels of territorial authority: the federation (*Bund*); nine federal provinces; and local authorities. The country's constitution contains a general clause giving the provinces responsibility for all matters which it does not specifically cover. As the environment was not a prominent issue when the constitution was drafted, the federation had no general competence in environmental matters. Environment therefore came under other explicit areas of competence such as water management, traffic, or trade and industry, leading to a large number of laws at federal and provincial levels. In 1972, environment became the explicit responsibility of the Federal Ministry of Health and Environmental Protection. This remained the case until 1987, when responsibilities were redistributed and the Federal Ministry of the Environment, Youth and Family Affairs was formed. It became the Federal Ministry for the Environment (BMU) in January 1995, with responsibility for general environmental policy, air quality, waste, chemicals, and the allocation of federal funding to the provinces.

To build on the country's previous success and tackle more recent environmental problems, Austria is developing a new approach embodied in the National Environmental Plan (NUP) and based on preventive measures implemented in an integrated way. Austrian environmental legislation is very wide-ranging and relies on stringent standards. Federal and provincial governments have adopted ambitious environmental goals and policies, and Austrian environmental expenditure in terms of GDP is among the highest in the OECD. The positive results obtained can also be partly explained by Austria's tradition of consensus building and close cooperation between all levels of public authorities and the non-government/private sector. It is expected that joint efforts in developing the NUP will help further strengthen cooperation and reinforce the sense of shared responsibility in moving towards sustainable development.

For more information, contact: OECD Publications, 2 rue André Pascal, 75775 Paris Cedex 16, France. Tel: +33 (1) 45 24 82 00. Fax: +33 (1) 49 10 42 76. Internet: Compte.PUBSINQ@oecd.org. ◆

La France élabore sa stratégie sur le développement durable

En juin 1997, cinq ans après Rio, une session spéciale des Nations Unies évaluera le dispositif mis en place pour promouvoir le développement durable dans le monde.

En prévision de cette session spéciale, la Commission Française du Développement Durable a été chargée de rédiger trois rapports pour contribuer à l'élaboration de la stratégie française, qui servira de base à la présence française dans les discussions internationales.

◆ *Priorités d'action* : ce rapport tente d'apporter une vision transversale, qui est l'une des caractéristiques du développement durable. Après un rappel des principes de durabilité, l'énoncé des approches politiques et des outils économiques sur lesquelles se fonde la mise en oeuvre d'un développement durable, le rapport développe des propositions regroupées en domaines complémentaires : institutions et réformes politiques

permettant la mise en oeuvre du développement durable, rôle des acteurs concernés, et enfin les champs d'action comme la gestion du territoire, les modes de production et de consommation et l'éducation du citoyen.

◆ *8 thèmes, 35 propositions* : ce rapport présente une synthèse des propositions pour la stratégie française du développement durable développées dans le volume précédent, qui sont ici groupées en huit thèmes.

◆ *Eléments de bilan* : ce rapport comprend quatre parties. Le premier chapitre rappelle les engagements internationaux et les actions menées par la France pour l'application de l'Action 21. Le second traite des points éthiques et politiques qui doivent présider à la mise en oeuvre du développement durable. Le troisième chapitre présente les champs d'application du développement durable et le dernier détaille les outils politiques et les méthodes à mettre en oeuvre pour permettre la durabilité du développement.

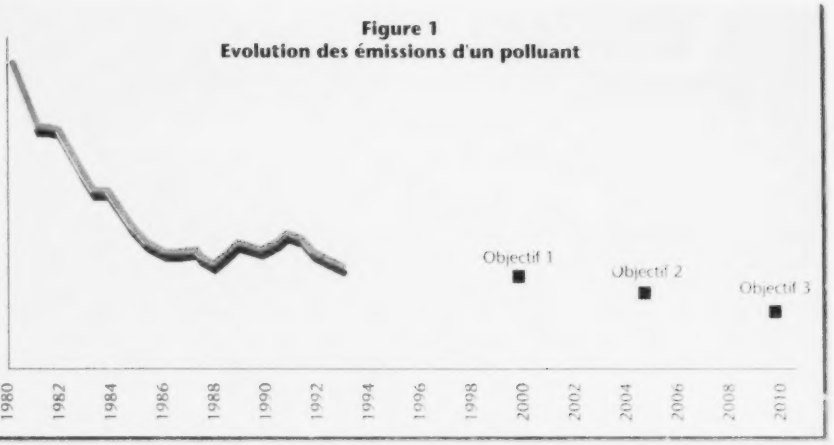
Pour de plus amples informations, contacter la Commission Française du Développement Durable, Ministère de l'Environnement, 20 avenue de Ségur, 75007 Paris, France. Tél : +33 (01) 42 19 11 95, Fax : +33 (01) 42 19 17 90. ◆

La France publie des indicateurs de performance environnementale

Le rapport *Indicateurs de performance environnementale de la France*, édité par l'Institut français de l'environnement, s'inscrit dans la logique d'évaluation des performances des politiques de l'environnement entreprise par l'OCDE depuis le début des années 90.

Les indicateurs environnementaux ont pour objet de quantifier des informations complexes et de les simplifier pour les rendre accessibles à un large public. En outre, ils ont pour vocation de confronter la situation environnementale aux engagements pris par l'Etat dans le cadre de textes officiels de niveau national (lois, décrets) ou international (directives et règlements européens, traités et conventions).

Figure 1
Evolution des émissions d'un polluant



La définition la plus générale de la performance est : « le résultat obtenu dans l'exécution d'une tâche ». A partir de cette définition, il est possible de cerner la spécificité de l'indicateur environnemental de performance :

◆ son sujet doit faire partie de la sphère d'action de la politique environnementale ;

◆ une valeur quantitative de référence, implicite ou explicite selon la forme de l'indicateur, doit apparaître clairement dans sa présentation.

Les références que l'on est susceptible d'utiliser pour l'élaboration d'indicateurs de performance sont d'origines diverses et se présentent sous différentes formes ; les indicateurs de performance qui en résultent seront donc également d'allures diverses. L'OCDE a proposé un modèle « Pression-Etat-Réponse » largement repris dans les études sur le sujet et qui permet une classification mettant en lumières ces différences de forme.

Indicateurs de pression

Pour le World Resources Institute (WRI), c'est à partir des indicateurs de pression qu'il est le plus facile de construire des indicateurs de performance.

Par exemple, de nombreux objectifs politiques, nationaux ou internationaux, concernent les réductions d'émission de polluants vers les différents média environnementaux. Ces objectifs sont souvent exprimés en pourcentage de réduction par rapport à une année de référence, comme le montre la Figure 1. Plus la date fixée pour atteindre l'objectif est proche et plus l'évaluation de la performance se fait aiguë. En revanche, une date éloignée témoigne d'une réflexion sur le long terme intéressante dans une optique de développement durable.

Indicateurs d'état

Pour construire un indicateur de performance à partir d'un indicateur d'état, on a en général recours aux normes de qualité comme valeur de référence. Ces normes spécifient les caractéristiques auxquelles doivent répondre les milieux récepteurs (eau, air, sol). Un exemple de ce type d'indicateur est donné par la Figure 2, où la norme de la qualité de l'OMS est prise comme référence.

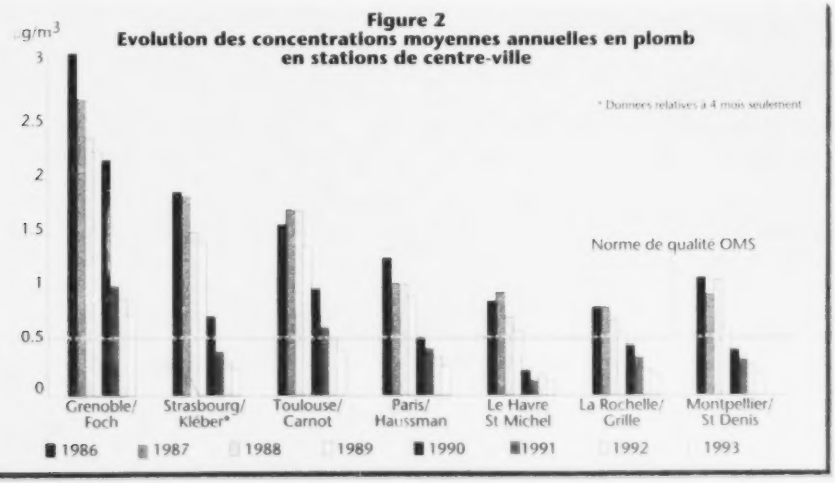
Indicateurs de réponse

Il est également possible d'élaborer des indicateurs de performance à partir d'indicateurs de réponse. Il serait souhaitable de pouvoir associer des objectifs de progression à ces indicateurs de réponse. Certains pays disposent par exemple d'objectifs quantitatifs de progression du recyclage des ordures ménagères qui permettent d'évaluer la performance de cette réponse politique au problème des déchets. Malheureusement, ces objectifs quantitatifs sont peu nombreux et l'examen de la performance vis à vis des réponses apportées par l'Etat aux problèmes environnementaux prend souvent la forme d'une évaluation de l'application effective sur le terrain des mesures décidées dans le cadre législatif ou réglementaire.

Le rapport est organisé en deux parties : la première définit les notions de performance et d'indicateurs de performance ; la deuxième s'articule en huit thèmes (Air, Eau, Sol, Nature, Déchets, Bruits, Risques et Ressources Naturelles) et 31 « fiches » ou enjeux environnementaux. Chaque fiche propose deux à cinq indicateurs de performance commentés.

Pour de plus amples informations, contacter l'Institut Français de l'Environnement, 61 Boulevard Alexandre Martin, 45058 Orléans Cedex 1, France. Tél : +33 (0)2 38 79 78 78, Fax : +33 (0)2 38 79 78 70. ◆

Figure 2
Evolution des concentrations moyennes annuelles en plomb en stations de centre-ville



Industry Updates

The Greenhouse Challenge Programme – voluntary agreements from Australian industry on reducing greenhouse gas emissions

Through the Greenhouse Challenge Programme, Australian companies or industry associations sign a cooperative agreement with the government to reduce greenhouse emissions, mainly through more efficient use of energy. A six-step process is involved:

- **Step 1 – Inventory of emissions:** Companies measure their present emissions to provide a benchmark for measurement of future performance.
- **Step 2 – Assessing opportunities:** Possible cost-effective actions are identified and an action plan for reduction of energy consumption and emissions is developed.
- **Step 3 – Goal setting:** Objectives are set and forecasts made of future savings.
- **Step 4 – Signing up:** Once the action plan is drawn up, companies prepare their cooperative agreements with the help of the Greenhouse Challenge Office.
- **Step 5 – Monitoring:** Companies measure their performance against each year's action plan. Keeping track of performance helps to identify new opportunities which can be added to action plans.
- **Step 6 – Reporting:** Companies prepare public statements. The Greenhouse Challenge Office provides help to companies in publicizing their efforts to reduce emissions.

The Greenhouse Challenge Office provides an array of tools and services to help companies develop their commitment to the programme. Since the programme is entirely voluntary, companies may withdraw from the process at any stage.

One company which has signed up to the Greenhouse Challenge is CRA Limited, a major mining concern employing more than 12,000 people which had sales in 1995 of $5.4 billion from aluminium, coal, iron ore, gold, diamonds and other commodities.

Between 1990 and 1996 the company cut greenhouse gas emissions by more than 5 per cent. It has initiated 78 gas abatement projects, which have reduced emissions by the equivalent of more than 500,000 tonnes of carbon dioxide (CO_2) per year. Under its Greenhouse Challenge cooperative agreement, CRA intends to proceed with a further 143 projects between 1996 and the year 2000. The company's action plan was developed from a detailed review of all aspects of business unit operations by management and employees, including process design and operation, equipment selection, power system efficiency, and building energy management. Internal guidelines were developed to enable individual sites to develop their own inventories and action plans.

CRA has spent more than $170 million on investigation, research, development and demonstration projects which will reduce greenhouse gas emissions. Some results of this investment are:

Boyne and Bell Bay smelters

A newly designed smelting control system which reduces greenhouse gases from anode effect is being introduced progressively. An eight-fold reduction in emissions has already been achieved at Boyne, and 60 per cent savings were expected at Bell Bay by the end of 1996.

Argyle Diamond Mine power supply

Hydroelectric power will replace most of the diesel power generated on site, reducing greenhouse gas emissions by 76,000 tonnes CO_2 equivalent per year.

Low-energy cell for aluminium smelting

Trials are underway at Bell Bay on the use of new low-energy cells developed by CRA. The lower power consumption resulting from use of these cells could reduce greenhouse gas emissions by as much as 790,000 tonnes CO_2 equivalent per year.

Hamersley transport operations

New, larger locomotives have been introduced which are 27 per cent more efficient than older engines. This has significantly reduced diesel fuel consumption, giving yearly savings of around 16,000 CO_2 equivalent.

For more information on Greenhouse Challenge, contact: The Greenhouse Challenge Office, Tel: +61 (6) 271 6400, Fax: +61 (6) 271 6450, E-mail: Greenhouse Challenge@regate.dpie.gov.au. Information is also available via the internet URL: http://www.dpie.gov.au/resources.energy/environment/greenhouse/challenge.html. ◆

The Jupiter Ecology Fund: encouraging green investment

The declared objective of the Jupiter Ecology Fund is to invest worldwide in companies that are responding positively to the challenge of environmental sustainability and are making a commitment to social well-being.

The fund is aided in its work by the Jupiter Environmental Research Unit, a team of researchers assessing companies' environmental and ethical performance. The research unit produces an Approved List of authorized shares from which the fund manager selects companies in which to invest. The selections are reviewed quarterly by an Advisory Committee of environmental specialists, who also offer advice on emerging environmental trends and guide the development of research methodology.

The fund avoids investments in companies deriving more than 1 per cent of their turnover from the armaments, gambling, nuclear, pornographic publications or tobacco industries, or more than 10 per cent from alcoholic drinks. In assessing companies from other sectors, the fund adopts what it describes as a "positive" approach. This means identifying and investing in companies which are actively reducing their eco-footprint, rather than simply screening companies' activities and rejecting them for investment if they breach predetermined criteria. Taking the positive approach means that companies making a serious commitment to best practice can be selected for investment even if their track record is imperfect. This approach also has the merit of requiring a constructive dialogue between assessors and a company, which can itself produce environmental and social benefits.

A sector in which the Ecology Fund has avoided investing, but which the Research Unit recently decided to review, is banking. The major barrier to investment has always been the difficulty in screening banks' lending portfolios. Lending is a private business. The Ecology Fund cannot therefore ascertain to whom loans have been made, making it impossible to judge whether they are used to benefit activities not meeting the Fund's ethical and environmental criteria. The review process was triggered by the number of banks which have become signatories to the *Statement by Banks on Environment and Sustainable Development*, issued five years ago next spring. More than 60 banks have signed this declaration of intent, in which they undertake "to endeavour to ensure that their policies and business actions promote sustainable development." To date, Scandinavian, Swiss and UK banks have been assessed. Others are to be assessed in the near future.

Although the review found that banks have not yet developed systems in which environmental issues are routinely taken into account, and concluded that the sector is still not suitable for investment, it also noted that progress had been made. For example, a bank in Switzerland operates a system whereby all domestic (i.e. Swiss) corporate lending must be screened for environmental risk. A Scottish bank recognizes the need to "work with customers in identifying activity which would lead to them encountering difficulties under environmental protection legislation." Progress, it seems, is largely driven by financial concerns arising from potential lender liability for environmental costs.

In addition to assessing lending practices, the review also addressed the question of banks' internal practices, such as energy efficiency measures and supplier assessments. Here again progress has been made, with at least one bank implementing an environmental management system and another incorporating environmental performance specifications into the design of its new head office.

For more information, contact: Jupiter Environmental Research Unit, Jupiter Assessment Management Limited, Knightsbridge House, 197 Knightsbridge, London SW7 1RB, UK. Tel: +44 (0171) 412 0703, Fax: +44 (0171) 581 3857. ◆

UNEP Focus

UNEP announces 1996 Sasakawa Environment Prize winner

In November 1995, UNEP announced that the 1996 Sasakawa Environment Prize had been awarded to Dr Tiloki Nath Koshoo, a scientist from India, in recognition of his outstanding contribution to the protection and management of the environment.

Dr Koshoo has been involved in many areas of environmental science for more than 30 years, and has been a strong advocate of regional environmental planning for long-term ecological and economic security, especially in the developing country context.

Dr Koshoo's work in cytogenetics, biological diversity, biomass production, and environmental research and development has earned him a place as a leader in the environmental field. His work has generated a large body of new knowledge regarding the genetic-evolutionary race history of a number of plants. He has, for the first time, delineated centres of diversity and origin, circumscribed gene pools, and standardized procedures for studying the taxonomy of cultivated plants.

Dr Koshoo's pre-emptive strategies based on sound scientific analyses, implemented while he was Secretary to the Government of India's Department of the Environment, resulted in policies which have helped protect the country from further environmental damage.

Dr Koshoo has also initiated work on the standardization of herbal drugs and compound formulation, particularly for rural use and development. More recently, he has turned his attention to the evolutionary implications of the variation in DNA content in chromosperms of gymnospermous taxa and other trees, relating these data to their habitat and other aspects of the environment. This work has been of considerable practical importance in helping to map out forest tree breeding programmes for this economically and environmentally important group of plants.

The annual UNEP Sasakawa Prize, accompanied by a US$ 200,000 award, is considered one of the most prestigious environmental awards in the world. It was first awarded in 1984, and is given to "nominated individuals who have made an outstanding global contribution to the management and protection of the environment". Previous winners include: Chico Mendes, the rubber tapper from Brazil who died leading the fight against destruction of the rain forest by cattle ranchers; Dr M.S. Swaminathan, the father of the Indian economic ecology movement; and Lester Brown, Director of the WorldWatch Institute.

Dr Koshoo's prize was officially awarded to him at a ceremony on 30 November 1996 in New Delhi, India. The ceremony was attended by Her Royal Highness Princess Chulabhorn of Thailand and Lord Stanley Clinton-Davis, both members of the prize selection committee, and by Ms Elisabeth Dowdeswell, UNEP's Executive Director.

For more information, and to obtain 1997 nomination forms, contact: Ms Elisabeth Guilbaud-Cox, Secretary, UNEP Sasakawa Environment Prize, P.O. Box 30552, Nairobi, Kenya. Tel: +254 (2) 62 3401, Fax: +254 (2) 62 3927, E-mail: elisabeth.guilbaud@unep.org ◆

International Conference on ISO 14000 and Sustainable Development – Beijing

The International Conference on ISO 14000 and Sustainable Development was held in Beijing, China, on 5-7 November 1996. It was organized by NEPA with IISD and UNEP.

The meeting was attended by 150 Chinese participants from environmental protection bureaus, enterprises and academia as well as 50 international participants from intergovernmental and non-governmental organizations and transnational corporations.

The main conclusions of the meeting were: China is to launch activities relating to ISO 14000 to build on work already done on cleaner production and environmental management systems (EMS). Participants clearly fully appreciated the importance of certification with the new standard in meeting international trade requirements. Within China, CCEMS will promote ISO 14000 and will certify that EMS are in place. A number of organizations, including China's National Cleaner Production Centre (NCPC), will help to promote the development of EMS in Chinese enterprises. Finally, UNEP, FIDIC and ICC announced their intention to organize a one-week train-the-trainers workshop on EMS, back-to-back with the ICC's international conference in Shanghai in April 1997.

For more information, contact: UNEP IE, Tour Mirabeau, 39-43 Quai André Citroën, 75739 Paris Cedex 15, France. Tel: +33 (1) 44 37 14 50, Fax: +33 (1) 44 37 14 74. ◆

UNEP IE activity summary

UNEP IE works on a wide range of issues in several distinct work programme areas. Several of these are described in more detail in biannual newsletters. For more information on all activities mentioned, contact UNEP IE.

Awareness and Preparedness for Emergencies at Local Level (APELL)

J. Stevens, the APELL Programme Coordinator, participated in the meeting of the Advisory Group on Environmental Emergencies, held on 3-4 October in Geneva. The meeting was organized by the UNEP/DHA Joint Unit.

The Fifth APELL Senior Level Expert Advisory Group Meeting was held in Paris on 7-9 October. The meeting was attended by 70 participants from 33 countries, representing govern-

The International Conference on ISO 14000 and Sustainable Development. From the left: Ms Jacqueline Aloisi de Larderel, Director, UNEP IE; Ms Li Rui, President, Chinese Association for Standardization; Mr David Runnalls, IISD; Mr Xie Chenchua, Administrator, and Mr Ye Ru Qiu, Deputy Administrator, NEPA; Mr Raymond Van Erman, Director, European Partnership for the Environment, European Environment Bureau.

ments, industry, NGOs, and other UN organizations. The meeting was opened jointly by Ms J. Aloisi de Larderel, Director of UNEP IE, Mr Jim Makris, Director of the Chemical Emergency Preparedness and Prevention Office, US EPA, and Dr Allan Jones, Vice-President, Operations and Environmental Affairs, Rhône-Poulenc, Canada, and MIACC Chairman. The meeting provided a forum for exchanges of experience and provided input for the 1997-1999 APELL Work Programme.

On 29-30 October, J. Morton, a Senior Industry Consultant took part in a two-day APELL training session which was part of a four-week course in Emergency Preparedness and Response, organized by SSPA Maritime Consultants. The course is provided by the Swedish government for participants from developing countries.

The biannual APELL Newsletter is available in English, French and Spanish and is a free of charge supplement to Industry and Environment.

Cleaner Production (CP)

G. Clark participated in the ILO/UNEP Cleaner Production Seminars for National Employers' Organizations held on 9-11 October in India and 14-17 October in Zimbabwe. The purpose of the seminars was to explain the Cleaner Production concept to employers' associations, so that they in turn will be able to support the design and implementation of cleaner production activities in companies. The meeting in India was attended by representatives from China, India, Indonesia, Malaysia and the Philippines, while the Zimbabwe event brought together participants from Kenya, Mauritius, Sri Lanka, Tanzania, Trinidad and Tobago, and Zimbabwe. Industrial sectors were selected from those that have high environmental impacts and a high potential for payback from good housekeeping measures. These included: agro-food processing (including fisheries), biotechnology, textiles, electronics, metal finishing and tourism.

Uno Abrahamszn, a senior member of the CP team provided input to the Environmental Northern Seas Conference Committee Meeting in Oslo on 14-16 October and to the Waste Minimization Workshop in Berlin, 17-18 October.

UNEP IE also participated in the Third European Roundtable on Cleaner Production in Kalundborg, Denmark, on 1-4 November. The CP Programme Coordinator gave a keynote address to the roundtable meeting.

Jon Hobbs, the Programme Coordinator participated in the Annual Meeting of the National Cleaner Production Centres Directors in Inyanga, Zimbabwe. UNEP's input covered ISO 14001 and cleaner production, a review of UNEP's role in partnership with UNIDO, and bilateral negotiations with each centre to decide on priority activities for 1997.

The biannual CP Newsletter is available in English, French and Spanish and is a free of charge supplement to Industry and Environment.

OzonAction

At its 20th meeting in Montreal on 16-18 October, the Executive Committee of the Multilateral Fund approved amendments to UNEP's 1996 Work Programme of US$ 0.6 million, bringing the year's total to US$ 4.2 million. Eight more Country Programmes were approved (Bahrain, Croatia, Ethiopia, Honduras, Jamaica, Lesotho, Pakistan and Tanzania), bringing the number of UNEP-assisted Country Programmes to date to 49. Seven Institutional Strengthening projects were also approved (Jamaica, Ethiopia, Lesotho, Croatia, Bahrain, Honduras and Tanzania), bringing the total to 42.

At the 1996 International Conference on Ozone Protection Technologies (Washington, DC, 21-23 October), the OzonAction Programme conducted a number of activities, including organizing the annual *Roundtable Discussion on Knowledge Sharing Networks for ODS Phase Out* (this year focusing on policy instruments required by developing countries to comply with the Montreal Protocol), moderating a session on *Policies and Compliance*, making a presentation in the *Technology Transfer* session, and hosting an exhibit booth to outreach the programme.

The OzonAction Programme initiated the Caribbean Network of ODS Officers following a mission to the Bahamas, Barbados, Nassau and St Lucia from 7-11 October. The Network of ODS Officers for French-speaking Africa held a workshop in Abidjan (4-7 November), and the Network for Central America, Mexico and the Spanish-speaking Caribbean held its meeting in San José, Costa Rica (13-17 November).

The programme also participated in various meetings associated with the 8th Meeting of the Parties to the Montreal Protocol (Costa Rica).

An overall approach to assist small and medium-sized enterprises (SMEs) with ODS phase-out is being developed jointly with UNDP.

The OzonAction Newsletter is published quarterly and is available free of charge from the OzonAction Programme at UNEP IE.

Tourism

See page 57 for news of activities on tourism.

Global Industrial Management

A workshop on the EMS Kit was held as part of the ISO 14000 Conference, organized by UNEP, IISD and NEPA in Beijing, China, from 5-7 November 1996. The Chinese translation of the Kit was launched at this Conference.

The "Engaging Stakeholders" publications were completed. Prepared by SustainAbility with UNEP and the New Economics Foundation, these two volumes provide a wide range of perspectives and tools to help both report-makers and report-users in their work.

Volume 1, *The Benchmark Survey*, covers the latest international trends in corporate environmental reporting, introduces new and revised reporting and benchmarking tools, and summarizes the results of the 1996 UNEP/SustainAbility benchmark survey reports.

Volume 2, *The Case Studies*, focuses on the activities and perspectives of twelve very different users of corporate environmental reports, from countries as different as Sweden and Thailand.

On 21-22 October, UNEP and IISD held a meeting, "Setting Goals for ISO 14000", attended by key industry representatives. A project proposal for future work in this area is under development.

Industrial Pollution Management

A senior consultant represented UNEP at the 64th Annual Meeting of the International Commission on Large Dams, held 13-19 October in Santiago, Chile. The annual meeting included Executive Meetings, Technical Committee Meetings, and a two-day Symposium on Tailings and Seismic Activity. The event was attended by around 600 delegates representing at least 40 different countries.

Of particular interest to UNEP was the issue of current trends in safety legislation and the

related issue of a comparison of international legislation (safety and environment). After discussion, the Tailings Committee merged these two topics and requested that UNEP consider being the lead organizer of a subcommittee to address these issues.

A second issue of importance to UNEP was the reporting of incidents associated with tailing structures. The Technical Committee acknowledged that UNEP's funding of the Mining Journal Research Service publication *Tailings Dam Incidents, 1980-1996* represented a considerable step in this direction. The committee agreed to seek a common format for incident reporting, with particular emphasis being placed on the geotechnical and other engineering aspects of each incident, so that a worldwide technical data base could be built up in a systematic manner.

On 22-24 October 1996 a small group of experts from Canada, India, Sri Lanka, Thailand and the USA met with UNEP representatives and Environment Canada in Halifax, Nova Scotia, to prepare a new guideline document for industrial estates. The project grew out of a first meeting held by UNEP IE in 1995, at which it was decided to prepare practical guidelines for use by estate planners and managers.

From October to December 1996 work continued on forthcoming reports and publications covering oil exploration and production, fertilizer production, pulp and paper, and the iron and steel industry. A manual entitled *Monitoring Industrial Emissions and Wastes* was also printed during this period.

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Books & Reports

GENERAL

Environmental Benchmarking – Becoming Green and Competitive

Business leaders have often been asked to meet seemingly irreconcilable demands to maintain or achieve good economic results while at the same time playing a major role in protecting the environment. However, achieving these apparently conflicting demands is increasingly not only proving possible but being used to obtain a critical competitive advantage. The primary objective of *Environmental Benchmarking – Becoming Green and Competitive*, a new title in the Business and the Environment – Practitioner series, is to aid managers incorporate environmental dimensions into their daily business practices in ways that allow them to protect the environment and to increase their competitive ability in the long term.

The method proposed is benchmarking, an activity that encompasses the comparison of various business activities and practices such as the design of products and services; the development and adoption of cleaner technologies; the elaboration and implementation of effective communication skills; environmental management strategies; and other activities that implicitly or explicitly affect the environment.

The authors take a pragmatic approach, basing their material on the experiences of business managers who have learned – mostly by trial and error – to deal with environmental issues in an effective manner, and extracting lessons that can be followed by others.

Francisco Szekely, Thomas Vollman and Anette Ebbinghaus (1996). Customer Services Department, Stanley Thomas (Publishers) Limited, Ellenborough House, Wellington Street, Cheltenham, Glos. GL50 1YW, UK. Tel: +44 (01242) 228586. Fax: +44 (01242) 221914. Pbk, 133p. ISBN 0-7487-1848-6.

A Guide to Tailings Dams and Impoundments – Design, Construction, Use and Rehabilitation – Bulletin 106

Following a number of well publicized incidents around the world, renewed attention has been focused on the need for correct management of tailings. The International Commission on Large Dams (ICOLD) and UNEP have produced this bulletin, which addresses both the safety and environmental issues associated with tailings impoundments. The bulletin discusses common problems in the disposal of tailings at mines, quarries and in other industries and identifies safe methods of designing and operating dams and impoundments. This is a parallel text, in French and English.

United Nations Environment Programme Industry and Environment centre, Tour Mirabeau, 39-43 quai André-Citroën, 75739 Paris Cedex 15, France. Tel +33 (1) 44 37 14 50, Fax: +33 (1) 44 37 1474. Pbk, 239p. ISBN 92-807-1590-7.

Vital Signs 1996 – The Trends that Are Shaping Our Future

This book from the WorldWatch Institute offers the opportunity to study in graphic form the long-term global trends that are changing our lives, for better or worse. More than 100 graphs and tables, accompanied by concise analysis, allow tracking of key indicators that show social, economic and environmental progress or the lack of it; for example, the steady rise in global temperature (1995 was the warmest year since record-keeping began) or in global wind-power capacity, which exceeded 5000 megawatts in 1995 and is the world's fastest-growing energy source. *Vital Signs 1996* also covers subjects as diverse as food and military trends and HIV/AIDS.

Lester Brown, Christopher Flavin and Hal Kane (1996). W.W. Norton and Company, Inc. 500 Fifth Avenue, New York, N.Y. 10110, USA. Pbk, 169 p. ISBN 0-393-31426-X.

European Economic Integration and Sustainable Development – Institutions, Issues and Policies

European Economic Integration and Sustainable Development gives a comprehensive examination of the objectives, institutions and ongoing development of the European Union as a unique supranational entity.

The text analyses EU policies, demonstrating the tension between economic integration and the subsidiarity principle, and highlights the increasing emphasis being placed on sustainable development in key policy areas.

Robert Barrass and Shobhana Madhavan (1996). McGraw-Hill Book Publishing Company Europe, Shoppenhangers Road, Maidenhead, Berkshire SL6 2QL, UK. Tel: +44 (01) 628 23432, Fax: +44 (01) 628 770224. Pbk, 315p. ISBN 0-07-707836-5.

Towards Corporate Environmental Excellence – The Role of Business in Sustainable Development

Towards Corporate Environmental Excellence furnishes glimpses of past and present initiatives by business in the journey towards environmentally sound and sustainable development, as well as a practical agenda for action to guide corporations and their stakeholders in addressing environmental issues. The book is based on the plenary papers and success case studies presented at the first Global 500 Forum International Conference in Kuala Lumpur, Malaysia, in October 1995. Topics include environmental management, accounting reporting and benchmarking, working with international institutions and instruments, expectations of youth by industry, and the sustainable development practices of various businesses and industries throughout the world.

The text is accompanied by a photoessay, "Reflections of the Future", by the photographer Mark Edwards.

World Wide Fund for Nature (WWF) Malaysia, Locked Bag N° 911, Jalan Sultan P.O., 46990 Petaling Jaya, Selangor, Malaysia. Tel: +60 (3) 7033772, Fax: +60 (3) 7035157. Hbk, 147p.

Environmental Issues and Business – Implications of a Changing Agenda

Business is increasingly interested in responding positively to environmental issues. The nature of this response deserves close attention, because it influences not only business operations but also the wider context of policy, public opinion and environmental concern.

Environmental Issues and Business details the dimensions of the business response to environmental issues by taking a critical social science perspective on this dynamic area. It catalogues the pressures on business to engage in environmental activities and then assesses those activities in terms of company culture, communication, and influence on the environmental agenda. Using examples from the United States and Europe, the book examines the diversity of business activities and evaluates their impact according to policy developments and the restoration of public confidence. Environmental policy and auditing, environmental advertising, and marketing and environmentally based communications illustrate how business has approached this task.

Sally Eden (1996). John Wiley and Sons Ltd., Baffins Lane, Chichester, West Sussex PO19 IUD, UK. Tel: +44 (1243) 779777. Hbk, 195p. ISBN 0-471-94872-1.

Environmental Risks and Rewards for Business

This book stems from a conference on the subject of environmental risks and rewards for business held in Copenhagen in May 1995. It examines the essential questions confronting European business interests, their attitudes, their suspicions and doubts, and their positive support for environmental initiatives (as well as the lip service sometimes paid to them). In analysing the fundamental shifts in economic and social patterns over the next decade, it draws lessons from the past based on specific case studies and from experience in the US.

Herbert Enmarch-Williams, ed. (1996). John Wiley and Sons Ltd., Baffins Lane, Chichester, West Sussex PO19 IUD, UK. Tel: +44 (1243) 779777. Hbk, 195p. ISBN 0-471-94872-1.

Indicators of Sustainable Development Framework and Methodologies

At its third session in April 1995, the Commission on Sustainable Development (CSD) approved a work programme on indicators of sustainable development. The work programme included a list of approximately 130 indicators organized in the Driving Force – State – Response Framework. In this framework, Driving Force indicators represent human activities, processes and patterns that impact on sustainable development; State indicators indicate the "state" of sustainable development; and Response indicators indicate policy options and other responses to changes in the state of sustainable development.

The indicators are intended for use in national decision-making processes. Following the decision by the CSD to adopt an implementation plan, methodology sheets began to be developed for each of the indicators. The purpose of these sheets (which are illustrated) is to provide users at the national level with sufficient information about the concept, significance, measurement and data sources for each indicator to facilitate data collection and analysis.

United Nations Sales Section, Geneva. Pbk, 428p. ISBN 92-1-104470-7.

Report of the SETAC/OECD Workshop on Avian Toxicity Testing

This document contains the report of a Workshop on Avian Toxicity Testing which took place in Pensacola, Florida, in December 1994. The Workshop was jointly organized by the Society of Environmental Toxicology and Chemistry (SETAC) and the Organisation for Economic Co-operation and Development (OECD).

The specific objectives of the Workshop were to:

- consider the fundamental reasons why information about the toxicity of chemicals to birds is needed, and thereby identify the critical features which are essential for the tests used to generate this information;
- evaluate the positive and negative features of existing test methods, and of proposed alternatives, against the required critical features;
- develop proposals for the revision and development of OECD Test Guidelines for avian toxicity and avoidance tests, as appropriate, and for a framework to govern the way these tests are requested and used in practice in risk assessment.

OECD Environmental Health and Safety Division, 2 rue André-Pascal, 75775 Paris Cedex 16, France. Tel: +33 (1) 45 24 82 00, Fax: 45 24 16 75. Pbk, 198p. Free of charge; available electronically (also at no charge) on the OECD's World Wide Web site: http://www.oecd.org/ehs/.

Consensus Document on General Information Concerning the Biosafety of Crop Plants Made Virus Resistant Through Coat Protein Gene-Mediated Protection

OECD countries are moving rapidly towards the commercialization and marketing of agricultural and industrial products of modern biotechnology. They have therefore identified the need for harmonization of regulatory approaches to assess these products, in order to avoid unnecessary trade barriers.

As a step towards harmonization, the OECD's Expert Group on Harmonization of Regulatory Oversight in Biotechnology instituted the development of "consensus documents" which are mutually acceptable among OECD countries. This is the first of these consensus documents.

OECD Environmental Health and Safety Division, 2 rue André-Pascal, 75775 Paris Cedex 16, France. Tel: +33 (1) 45 24 82 00, Fax: 45 24 16 75. Pbk, 198p. Free of charge; available electronically (also at no charge) on the OECD's World Wide Web site: http://www.oecd.org/ehs/.

Corporate Environmental Management

This book presents a comprehensive analysis of the role of business in safeguarding the environment. It introduces the general issues and context, and then gives a detailed critical examination of all the key tools of corporate environmental management, including environmental management systems and standards; environmental policies, guidelines and charters; environmental auditing; life-cycle assessment; measurement of environmental performance; and environmental reporting. The book concentrates on systems-based environmental management and considers how such an approach might be integrated within local authorities and small and medium-sized companies. It also extends the systems approach to cover continuous environmental improvement, building a corporate environmental profile, and moving towards sustainability.

Richard Welford (1996). Earthscan Publications Limited, 120 Pentonville Road, London N1 9NJ,

UK. Tel: +44 (0171) 278 0433, Fax: +44 (0171) 1142. Pbk, 273p. ISBN 1-85383-308-8.

Water Resources Assessment in the ESCWA Region Using Remote Sensing and GIS Techniques

This book is the result of a joint project of UNEP, the Islamic Development Bank (IDB) and the Economic and Social Commission for Western Asia (ESCWA).

Proper assessment, planning and development of water resources are key elements in the overall social and economic development of individual countries and regions. Improper management and planning, due to either lack of data or inadequate studies, has often resulted in overdevelopment, water quality deterioration, and water supply problems. *Water Resources Assessment in the ESCWA Region Using Remote Sensing and GIS Techniques* comprises a review of hydrological and hydrogeological reports and new hydrological and hydrogeological maps of the ESCWA region, made with the help of remote sensing techniques. The publication of these reports and their systematic compilation in map form will make a valuable contribution to the assessment of water resources in the region.

(1996). UNEP, P.O. Box 30552, Nairobi, Kenya. Tel: +254 (2) 621234, Fax: +254 (2) 226886/226890. Hbk, 264p.

The Environmental Management of Low-Grade Fuels

The negative environmental impacts of energy use continue to present serious policy dilemmas. The release of emissions and effluents and the build-up of solid waste throughout the fuel cycle have disruptive effects on natural habitats and human health. Moreover, fuel combustion can result in the emission of carbon dioxide, ozone, methane and nitrogen dioxide, which have been linked to climate change. The safe and sustainable use of energy is an important issue in the environmental debate.

In *The Environmental Management of Low-Grade Fuels* researchers from the Stockholm Environment Institute explore the issues raised by the use of low-grade fuels such as peat, wood, biomass, lignite, oil shale, and municipal and industrial wastes. Strategies and policy options are presented for all stages of the process, from mining and transport to processing and combustion.

Mary MacDonald, Michael Chadwick and Gareg Aslanian (1996). Earthscan Publications Limited, 120 Pentonville Road, London N1 9JN, UK. Tel: +44 (0171) 278 0433, Fax: +44 (0171) 278 1142. Hbk, 271p. ISBN 1-85383-339-8.

Profit Without Plunder – Reaping Revenue from Guyana's Tropical Forests Without Destroying Them

Governments in many tropical countries are under intense pressure to make short-term profits by selling their forest resources to foreign firms. In 1993 Suriname, whose economy was close to collapse, invited foreign investors to explore the possibilities of establishing logging concessions. If the proposed contracts had been accepted, between 25 and 40 per cent of the country's land area might have been logged under conditions that would have caused severe environmental damage. This situation was avoided, in part, thanks to a report by Dr Nigel Sizer, a Senior Associate of the World Resources Institute (WRI), and Richard Rice, director of economic policy at Conservation International.

More recently the government of Guyana, a near neighbour of Suriname, was faced with a similar situation. Aware of the report on Suriname, Guyana's president called in Dr Sizer to examine ways the country could obtain revenue from its forest resources without destroying them. Dr Sizer's answers to this question are published in *Profit Without Plunder*. Guyana is far from being the only country faced with this problem. The solutions proposed in the report could help other countries find alternatives to ill-planned and poorly monitored timber harvesting.

N. Sizer (1996). World Resources Institute, 1709 New York Avenue, NW Washington, DC 20006, USA. Tel: +1 (202) 638 6300, Fax: +1 (202) 638 0036. Pbk, 68p. ISBN 1-56973-103-9.

New Partnerships for Sustainable Agriculture

Agricultural productivity has risen dramatically in the second half of the 20th century. The remarkable increase in productivity has stemmed largely from the introduction of newly developed "super strains" of rice, wheat and other crops, together with greater use of agro-chemicals. By 1995, annual global pesticide sales reached US$ 29 billion. However, in many places rising costs, diminishing returns, and the harmful health impacts of this approach to agriculture have prompted farmers to try alternatives. Increasingly they are turning to integrated pest and crop management, and relying less on modern agro-chemicals and more on nature's species diversity, adaptability, and nutrient recycling capacity. However, if farmers are to be encouraged to consider alternatives, and if projects are to be successful, vital elements such as collaboration, farmer participation, and policy support must not be overlooked. These elements, every bit as important as new technical knowledge, are explored in the *New Partnerships for Sustainable Agriculture* report.

The nine partnerships described in this report span the United States, Asia, Africa and Latin America. All revolve around the implementation of practical alternatives to conventional chemical-intensive agriculture. The studies in the report show how alternatives have been put into practice in a variety of situations – from Kenya, where tsetse fly traps collectively maintained by farming communities are keeping trypanosomiasis in check, to California, where farmer-to-farmer extension and education are revolutionizing orchard cultivation. Each case study highlights the roles of farmers and the many other collaborators needed to make alternative agriculture work, and all take into account the complex web of values and interactions that shapes any approach to farming.

Lori Ann Thrupp, ed. (1996). World Resources Institute, 1709 New York Avenue, NW, Washington, DC 20006, USA. Tel: +1 (202) 638 6300, Fax: +1 (202) 638 0036. Pbk, 136p. ISBN 1-56973-103-9.

Towards a Sustainable Paper Cycle

The pulp and papermaking industry and the forestry associated with it have been the subject of criticism since environmental preoccupations became evident. Most of the industry has taken these criticisms seriously and improvements are being made, often requiring very heavy investment.

To encourage objective debate on these issues, the World Business Council for Sustainable Development (WBCSD) felt it necessary to obtain an independent study, commissioned from the IIED. The comprehensive report resulting from this study, *Towards a Sustainable Paper Cycle*, covers existing practices and levels of consumption at every stage of the paper life-cycle, as well as proposing perspectives on a more sustainable cycle

(1996). The World Business Council for Sustainable Development, 160 route de Florissant, CH-1231 Conches – Geneva, Switzerland. Tel: +41 (22) 839 3100, Fax: +41 (22) 839 3131. Pbk, 258. ISBN 1-899825-40-1.

Current Policies, Strategies and Aspects of Environmental Impact Assessment in a Transboundary Context

This publication from the UN Economic Commission for Europe describes current practice with respect to implementation of environmental impact assessment (EIA), particularly in a transboundary context. It contains four documents on policies, strategies and aspects of EIA, with an emphasis on the transboundary context, which were finalized and recommended for publication by the Meeting of the Signatories to the EIA Convention.

(1996). United Nations Sales Section, Geneva, Switzerland. Pbk, 74p. ISBN 92-1-116647-0.

Environmental Performance in OECD Countries – Progress in the 1990s

The OECD Environmental Performance Review Programme conducts peer reviews of environmental conditions and progress in each OECD country and scrutinizes efforts to meet both domestic objectives and international commitments. Evaluating progress in reducing the

pollution burden, improving natural resource management, integrating environmental and economic policies, and strengthening international cooperation are also central to these reviews. These analyses are supported by a broad range of economic and environmental data indicators.

Environmental performance reviews of Germany, Iceland, Norway, Portugal, Japan, Italy, the United Kingdom, Poland, the Netherlands, Austria, Canada and the United States have been published.

(1996). OECD Publications, 2 rue André Pascal, 75775 Paris Cedex 16, France. +33 (1) 45 24 82 00, Fax: +33 (1) 49 10 42 76, Pbk, 66, ISBN 92-64-14769-1. Internet: Compte.PUBSINQ@oecd.org.

Beyond Boundaries: The International Dimensions of Public Participation for the Countries of Central and Eastern Europe

This is the third volume in a series by the Regional Environmental Center on public participation. It expands on earlier analyses to include the international and transboundary aspects of public involvement in environmental decision making.

Beyond Boundaries examines the legal and informal possibilities for access to environmental information and citizen participation in the process of negotiation, adoption, ratification and implementation of international treaties and agreements. It also addresses other public participation possibilities of an international nature which are important for central and eastern European countries, such as the European Union legislation which CEE countries must follow to become EU members and the public participation criteria for multilateral funding.

(1996). The Regional Environment Center for Central and Eastern Europe, Ady Endre ut 9-11, 2000 Szentendre, Hungary. Tel +36 (26) 311 199, Fax: +36 (26) 311 294, Pbk, 181p.

Has Environmental Protection Really Reduced Productivity Growth: We Need Unbiased Measures

Policies to promote human progress depend, to a large extent, on how progress is defined. In the industrialized world over the past century, progress has been measured mostly in terms of economic efficiency and growth. Adverse environmental, social and health impacts of economic change have never been counted as costs.

Because the slowdown in productivity in the US in the early 1970s coincided with the implementation of environmental laws, it has been argued that these laws were a root cause of productivity loss. Some studies have estimated the loss due to environmental legislation to be as high as 50 per cent in pollution-intensive sectors.

Has Environmental Protection Really Reduced Productivity Growth argues that this is a seriously flawed view of the world, flawed because the way the US and other industrialized countries have measured productivity growth fundamentally misrepresents the industrial process and inevitably points to environmental protection reducing productivity, regardless of the extent of the damage prevented. Waste products, the book argues, though an inevitable consequence of production processes, do not have market prices and their incremental cost to the economy is therefore difficult to measure. The study shows that, although such measurement is difficult, it is nevertheless possible, and then goes on to show how unbiased productivity measurement, which includes the cost of emissions to the economy, can be used instead of the current flawed indicators. Case studies from the electric power, pulp and paper, and agricultural sectors are used to illustrate how this methodological change can influence the record of productivity growth.

Roberto Repetto, Dale Rothman, Paul Faeth and Duncan Austin (1996). World Resources Institute, 1709 New York Avenue, N.W., Washington, D.C. 20006, USA. Tel: +1 (202) 638 6300, Fax: +1 (202) 638 0036, Pbk, 46p. ISBN 1-56973-101-2.

101 Steps Towards Sustainability

This publication from Eco-Counselling Europe presents 101 projects which point the way to sustainable development. A broad range of projects in 15 European countries are aimed at a target audience, from activists to water-well owners. Topics range from agriculture to waste reduction.

(1995). Umweltberatung Europa, Mariahilferstrasse 89/29, A-1060, Vienna, Austria. Tel: +43 (1) 5877393, Fax: +43 (1) 5877393 18, Hbk, 118p.

Environmental Impacts of Structural Adjustment Programmes: Synthesis and Recommendations

This document was prepared as a background paper for discussion at the UNEP/World Bank Workshop on Environmental Impacts of Structural Adjustment Programmes (SAP) held in New York in March 1995. It explores the extent to which economy-wide policies have revolved, or at least evolved, to realign themselves with the concept of sustainable development through *ex ante* integration with social and environmental policies. Also surveyed are the findings of studies that attempted *ex post* assessment of the environmental impacts of structural adjustment programmes and the way they have been addressed. The progress of successive structural adjustment programmes in incorporating environmental concern and, ultimately, in attempting holistic integration of economic, social and environmental policies is examined.

(1996). UNEP, Environment and Economics Unit, P.O. Box 30552, Nairobi, Kenya. Tel: +254 (2) 621234, Fax: +254 (2) 226886/226890, Pbk, 65p.

EDUCATION AND TRAINING

Education and Simulation in the Field of Renewable Energy in South and South-East Asia

This book contains the proceedings of the five-day follow-up seminar on education/simulation in the field of renewable energy in South and South-East Asia, held in New Delhi in March 1996. The proceedings are presented in four sections: Renewable Energy Education; Renewable Energy Technology; Country Presentations; and a postgraduate course on renewable energy in Oldenburg.

Anil Misra and Edu Knagge, eds. (1996). Outreach Cell, Tata Energy Research Institute, Dahari Seth Block, Habitat Place, Lodhi Road, New Delhi – 110 003, India. Tel: +91 (11) 460 1550/462 2246, Fax: +91 (11) 462 1770/463 2609, Pbk, 205p. ISBN 81-85419-22-1.

ET Worldwide – A Compendium of Opportunities in Environmental Training

This is the 14th issue of *ET Worldwide*, a periodic compendium compiled from publicly available information by UNEP's Environmental Training Unit. It contains information on more than 150 short and long training courses in more than 20 countries. Information is also given on possibilities for financial support for overseas students.

United Nations Environment Programme, P.O. Box 30552, Nairobi, Kenya. Tel: 254 (2) 621234, Fax: +254 (2) 226886/226890, Pbk, 96.

Regional Directory for Tertiary Level Environmental Training Institutions in West Asia

This directory has been prepared to aid those seeking qualified tertiary level institutions specializing in various environmental fields. It is published in both Arabic and English. The first section contains the tertiary level and other training institutes, listed according to countries (in Arabic) in alphabetical order. In the second section, the institutes are listed according to degrees offered and training activities.

(1994). UNEP ROWA, P.O. Box 10880, Manama, Bahrain. Tel: +973 276072, Fax: +973 276075, Pbk, 80p.

CHEMICALS, POLLUTION & ACCIDENTS

Methylene Chlorine Information Exchange Programme Survey Results

In July 1995 a questionnaire was distributed to OECD countries and the OECD's Business and Industry Advisory Committee (BIAC)

requesting information concerning the risk posed by methylene chloride (dichloromethane) production and by the use of methylene chloride and other paint stripping formulations. It also asked for information on risk reduction measures applied to these substances. The survey results are now available in report form. This is N° 6 in the OECD's Series on Risk Management. N° 2 in the series, *Methylene Chloride: Background and National Experience with Reducing Risk*, published in 1995, is an earlier and more comprehensive study of methylene chloride risk reduction activities in OECD countries. Both publications can be downloaded.

OECD Environmental Health and Safety Division, 2 rue André-Pascal, 75775 Paris Cedex 16, France. +33 (1) 45 24 82 00, Fax: 45 24 16 75. Pbk. Free of charge; available electronically (also at no charge) on the OECD, World Wide Web site: http://www.oecd.org/ehs/.

Sources of Cadmium in the Environment

Steps have been taken by several OECD countries to reduce unacceptable human and environmental risks from exposure to cadmium. *Sources of Cadmium in the Environment*, published by the OECD, includes the report from the OECD Cadmium Workshop, held in Sweden in October 1995, and more than 50 papers on a number of issues – health, environmental, economic and trade – pertaining to cadmium use.

For more information, contact: OECD Publications, 2 rue André-Pascal, 75775 Paris Cedex 16, France. Tel: +33 (1) 45 24 82 00, Fax: +33 (1) 49 10 42 76. Internet: Compte.PUBSINQ@oecd.org.

Fertilizers as a Source of Cadmium

A number of OECD countries have developed new methods and regulations to reduce the impact of cadmium present in soil as a result of the use of phosphate fertilizers. The 24 papers in this publication address issues relating to the use of cadmium-containing fertilizers. They represent a wide range of viewpoints, including those of governments and industry in both OECD and non-OECD countries.

For more information, contact: OECD Publications, 2 rue André-Pascal, 75775 Paris Cedex 16, France. Tel: +33 (1) 45 24 82 00, Fax: +33 (1) 49 10 42 76. Internet: Compte.PUBSINQ@oecd.org.

Industrial Water Soluble Polymers

Water soluble polymers have a wide range of applications, including use in building products, detergents, papermaking, textile finishing, agricultural mulches, and toiletries and other personal care products. *Industrial Water Soluble Polymers* deals with this topical area of material science, placing the emphasis throughout on specific industrial applications.

C.A. Finch, ed. (1996). Royal Society of Chemistry, Turpin Distribution Services Ltd., Blackhorse Road, Letchworth, Herts SG6 1HN, UK. Tel: +44 (1462) 672555, Fax: +44 (1462) 480947. Hbk. 136p. ISBN 0-85404-746-8.

Gas Oils (Diesel Fuels/Heating Oils) – Product Dossier

This product dossier is one of a series on the major groups of petroleum products. It collates the available health, safety and environmental data on gas oils.

Gas oils are used primarily in the production of fuels that are used in diesel engines and for both industrial and domestic heating. Some of these products may also be used as solvents.

(1996). Concawe, Madouplein 1, B-1030 Brussels, Belgium. Tel: +32 (2) 220 3111, Fax: +32 (2) 219 4646. Pbk, 61 p. Product Dossier N° 95/107.

The Chemistry of Paper

Total world annual consumption of paper is currently around 270 million tonnes, and it is expected to increase sharply as industrializing economies expand. The production of this fundamentally important material has implications in regard to a wide range of environmental issues, from use of forest resources to control of emissions and effluents.

Although essentially a mechanical process, the manufacture of paper involves a good deal of chemistry. *The Chemistry of Paper* provides an overview of the process of papermaking from a chemical perspective. It addresses both the chemistry of paper as material and the chemistry of its production, setting out the main principles involved.

J.C. Roberts (1996). Royal Society of Chemistry, Turpin Distribution Services Ltd., Blackhorse Road, Letchworth, Herts SG6 1HN, UK. Tel: +44 (1462) 672555, Fax: +44 (1462) 480947. Pbk, 190p. ISBN 0-85404-518-X.

Users' Manual for the IPCS Health and Safety Guides

This manual summarizes the basic information on chemical safety that is required for understanding the terms and concepts used in the International Programme on Chemical Safety (IPCS) Health and Safety Guides.

(1996). WHO, Distribution and Sales, CH-1211 Geneva 27, Switzerland. Pbk, 127p. ISBN 92-4-154485-6.

RECYCLING

Development of Superior Asphalt Recycling Agents Phase 1: Technical Feasibility – Technical Progress Report

This report documents the technical progress made in the US Department of Energy-funded project on "Development of Superior Asphalt Recycling Agents" in the period from 2 August 1994 to 1 August 1995.

About 27 million tonnes of asphalt and nearly 20 times as much aggregate are used each year to build and maintain over two million miles of roads in the US. Every twelve years on average these roads have to be reworked. Much of the millions of tonnes of rock and asphalt cannot be reused with present recycling technology. This results in considerable waste of material, both quality aggregate (which is diminishing in supply) and asphalt binder. A major barrier to recycling of asphalt is the lack of recycling agents. The objective of the research covered in this report is to establish the technical feasibility of determining the specifications and operating parameters necessary to produce high quality recycling agents.

US Department of Commerce, Technology Administration, National Technical Information Service, Springfield, VA 22161, USA. Tel: +1 (703) 487 4650. Pbk, 186p. DOE assigned identification number DE95016702.

WASTE MANAGEMENT

International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management

This book focuses on one major factor in the array of problems facing urban managers, especially in developing countries: the difficulty of managing municipal solid waste (MSW).

One of the impediments to cost-effective, environmentally sound management of MSW is the fact that lessons learned from the adoption of technologies and practices in a particular situation are often unknown elsewhere. Urban managers in charge of MSW management often find themselves having to make decisions with long-term consequences although they do not have sufficient knowledge of what those consequences may be. *International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management* aims to facilitate sharing of information about MSW management between managers in developing countries, and between managers from developing countries and those from industrialized ones. To provide guidance on issues relating to MSW management, the Source Book brings together experiences and ideas from Africa, Asia and the Pacific, Europe, Latin America and the Caribbean, and North America. In spite of the vast differences between these regions in terms of levels of economic development, climate, geography, environmental concerns, and social and cultural conditions, similarities across continents do emerge. A low-income tropical city in one region may, for example, face substantially the same difficulties in MSW management as one in another part of the world.

The Source Book is organized in three main sections covering topics from waste reduction and landfill to waste characterization and public

education. However, topics are not dealt with in isolation. The relationship between them is discussed in order to guide managers towards a single, overall approach to integrated waste management.

UNEP International Environmental Technology Centre, 2-110 Ryokuchi koen, Tsurumi-ku, Osaka 538, Japan. Tel: +81 (6) 915 4580. Fax: +81 (6) 915 0304. Pbk, 427p. ISBN 92-807-1503-8.

NATIONAL/REGIONAL

Environmental Management in the Australian Minerals and Energy Industries – Principles and Practices

This book has been compiled for the Australian Minerals and Energy Environment Foundation (AMEEF), established in 1991 to promote the implementation of sustainable development principles in Australia's minerals and energy industries.

The book gives a very comprehensive view of environmental effects and regulatory approaches. This is followed by a discussion of environmental management procedures and systems, including a description of the way the ISO 14000 standard can be introduced into a company. Management of specific issues such as water and air quality, and rehabilitation, are dealt with in separate chapters, based on examples and case studies.

The second part of the book looks in more detail at key mining sectors: coal, gold, iron and steel, bauxite, base metals, mineral sands, construction materials and petroleum.

David Mulligan, ed. (1996). University of South Wales, Sydney 2052, Australia. Tel: +61 (02) 9398 8900, Fax: +61 (02) 9398 3408. Hbk, 793p. ISBN 0-86840-383-0.

The Minerals and Metals Policy of the Government of Canada: Partnerships for Sustainable Development

This book describes the government's role, objectives and strategies, within areas of federal jurisdiction, in regard to the sustainable development of Canada's mineral and metal resources.

Canada remains among the foremost producers of minerals and metals in the world and is a leading exporter. The industry plays an essential role in the country's economy, providing jobs for some 340,000 people and forming the economic foundation of around 150 communities in the rural and northern regions. At a time when dramatic changes are occurring in Canada's minerals and metals industry, the new minerals and metals policy meets the challenges of these changes and responds to important government commitments to a strategy for sustainable development of this sector of industry. Available in both English and French.

Minerals and Metals Sector, Natural Resources Canada, Ottawa, Ontario K1A 0E4, Canada. Tel: +1 (613) 947 6580, Fax: +1 (613) 952 7501. Pbk, 25p. ISBN 0-662-81606-4.

TQM Practices in Asia-Pacific Firms

Quality is one of the items which is important for maintaining a competitive advantage in manufacturing and service industries. The Asian Productivity Organization (APO) has designated total quality management (TQM) as a priority area for activity. A survey of quality management practices in manufacturing and service sectors, covering eleven countries, was planned in 1993. The survey was carried out from summer 1993 to winter 1994. The survey reports were completed in spring 1995. This publication contains the conclusions and findings of the survey, along with the country survey reports and contributed papers.

Tomio Umeda, ed. (1996). Asian Productivity Organization, 4-14 Akasaka 8-chome, Minato-ku, Tokyo 107, Japan. +81 (3) 3408 7221, Fax: +81 (3) 3408 7220. Pbk, 407p. ISBN 92-833-2193-6.

Labor-Management Cooperation in Environmental Protection

Asian industrial relations in the 1990s have been moving towards greater harmony and cooperation between labour and management, with the ultimate objective of increasing productivity. One of the fields where workers and trade unions are ready to share the responsibility with management is environmental protection. There is increasing recognition of the need for proactive measures to protect the environment generally, as well as for improving the working environment through joint efforts. This can be achieved not only through creation of favourable environmental policies at the macro level, but also through labour and management working together in the workplace to prevent pollution and develop environmentally friendly organizations.

Against that background, this survey was conducted in nine Asian Productivity Organization (APO) member countries to study how workers and management cooperate in developing and implementing policies and programmes to improve the environment and quality of life in the workplace. This survey report is now available.

C.S. Venkata Ratnam, ed. (1996). Asian Productivity Organization, 4-14 Akasaka 8-chome, Minato-ku, Tokyo 107, Japan. +81 (3) 3408 7221, Fax: +81 (3) 3408 7220. Pbk, 222p. ISBN 92-833-2192-8.

MAP Technical Reports Series No. 103, 104 and 105

The Mediterranean Action Plan (MAP) Technical Reports Series contains selected reports resulting from the various activities performed within the framework of the components of the Mediterranean Action Plan: Pollution and Research Programme (MED POL), Blue Plan, Priority Actions Programme, Specially Protected Areas and Regional Marine Pollution Emergency Response Centres for the Mediterranean.

Three new reports are now available:

- No. 103: *Final Reports on Research Projects Dealing with Biological Effects (Research Area III).* Pbk, 128p. ISBN 92-807-1595-8.
- No. 104: *Final Reports on Research Projects Dealing with Eutrophication and Heavy Metal Accumulation.* Pbk, 156p. ISBN 92-807-1596-6.
- No. 105: *Assessment of the State of Pollution of the Mediterranean Sea by Zinc, Copper and Their Compounds.*

United Nations Environment Programme, PO Box 18019, Athens, Greece. Pbk, 287p. ISBN 92-807-1597-4.

Onshore Minerals and Petroleum Exploration

Representatives of the mining industry in Australia and the Australian Environment Protection Agency have worked together to collect and present information on a variety of topics that illustrate and explain best practice environmental management in Australia's mining industry.

Onshore Minerals and Petroleum Exploration – a module in the Best Practice Environmental Management in Mining series – will assist all sectors of the mining industry in protecting the environment and reducing the impacts of their activities by following the principles of ecologically sustainable development. The publication discusses best practice at all stages of the exploration process and illustrates the discussion with case studies which indicate how the process can be implemented with minimal environmental disturbance.

(1996). Office of the Supervising Scientist, Federal Environment Department, Level 2, Tourism House, 40 Blackall Street, Barton ACT 2600, Australia. Tel: +61 (06) 274 1832, Fax: +61 (06) 274 1519. Pbk, 60p. ISBN 0-642-19437-8.

Environmental Auditing

Unlike environmental impact assessment, environmental auditing as a separate process is not regulated in Australia. Environmental auditing protocols are not written into legislation, so there is no set method. However, there is an increasing trend towards statutory audits (required by legislation) and mandatory audits (required as a condition of approval, license or lease). In this context the *Environmental Auditing* module, from the Australian Environment Protection Agency's Best Practice Environmental Management in Mining series, describes what an environmental audit is, examines the potential benefits of the process for companies, and explains how to conduct an audit. Each section of the publication contains relevant case studies.

(1996). Office of the Supervising Scientist, Federal Environment Department, Level 2, Tour-

tion House, 40 Blackall Street, Barton ACT 2600, Australia. Tel: +61 (06) 274 1832, Fax: +61 (06) 274 1519. Pbk, 64p. ISBN 0-642-19438-6.

Environmental Impact Assessment for Roads

This manual, from the Swedish National Road Administration, outlines the Swedish experience in implementing regulations on environmental impact assessment which came into force in October 1993.

Swedish National Road Administration, 781 87 Borlänge, Sweden. Tel: +46 (243) 754 34, Fax: +46 (243) 755 50. Pbk, 54p.

DIRECTORIES

World Directory of Country Environmental Studies

This is the third edition of the World Resources Institute's reference report, prepared in collaboration with the World Conservation Union and the International Institute for the Environment and Development.

Over the past few years interest in environmental reporting has greatly increased, with countries regularly assessing their progress towards agreed-upon international and national goals. Many countries are developing national "green plans" and environmental action plans and strategies. A few countries are preparing national sustainable development strategies, and industrialized countries have gone one step further by agreeing to have outside teams of experts assess their progress towards environmental policy goals.

World Directory of Country Environmental Studies provides bibliographic information and a short abstract of all of these efforts. The directory includes information on how to obtain copies of the country reports.

(1995). World Resources Institute, 1709 New York Avenue, N.W., Washington, D.C. 20006, USA. Tel: +1 (202) 638 6300, Fax: +1 (202) 638 0036. Pbk, 271p. ISBN 1-56973-095-4.

TERI Energy Data Directory and Year Book

The 1996/97 issue of the Tata Energy and Research Institute (TERI) *Energy Data Directory and Year Book* (TEDDY) is now available. This issue of TEDDY comes at a time when demand for energy in India is exhibiting continued high levels, resulting from the accelerated growth in industrial production and in other sectors of the economy. The publication provides up to date and comprehensive data on the current situation regarding supply and demand for energy in India across a broad spectrum of sectors.

In parallel with this publication, TERI is also making selected energy data available on disc.

The Outreach Cell, Tata Energy Research Institute, Darbair Seth Block, Habitat Place, Lodhi Road, New Delhi – 110 003, India. Tel: +91 (11) 460 1550/462 2246, Fax: +91 (11) 462 1770/463 2609. Pbk, 470p.

Regional Directory of Environmental Resource Persons and Research in West Asia

This directory will be of assistance to those seeking qualified experts in various environmental fields in the West Asia region.

The first section contains names and addresses of 368 resource persons working in the region. The directory is a parallel text in Arabic and English.

(1994). UNEP ROWA, P.O. Box 10880, Manama, Bahrain. Tel: +973 276072, Fax: +973 276075. Pbk.

International Yearbook of Industrial Statistics 1996

A comprehensive source of information, the *International Yearbook of Industrial Statistics 1996* provides statistics on current performance and trends in the manufacturing sector worldwide.

(1996). Edward Elgar Publishing Limited, 8 Lansdown Place, Cheltenham, Glos, GL50 2HU, UK. Tel: +44 (1242) 226934, Fax: +44 (1242) 262111. Hbk, 642p. ISBN 9-781858-9847-11.

World Association of Industrial and Technological Research Organizations Directory

This is the ninth edition of what has become a well established reference tool. The World Association of Industrial and Technological Research Organizations (WAITRO) came into being following a UNIDO-sponsored meeting in Athens in 1976. The aim was to provide an international voice for technological research and development, a global clearing-house for technological information, and an agency for promoting cooperation between member research establishments.

The WAITRO directory, listing institutes and organizations by country, is part of a larger project to produce a data base of WAITRO member resources. A major objective of the project is to identify resources within the WAITRO membership which could be used for technical cooperation among developing countries.

Danish Technological Institute, P.O. Box 141, DK-2630 Taastrup, Denmark. Tel: +45 (43) 504350, Fax: +45 (43) 07050. Ringfile, 193p.

EDITIONS FRANCAISES

Que sais-je ? – L'énergie solaire

Cet ouvrage dans la célèbre collection *Que sais-je ?* passe en revue tous les aspects de la technologie solaire allant du panneau solaire simple aux systèmes photovoltaïques les plus complexes.

Le contenu ne se limite pas à une simple description technique : la nature de l'énergie solaire ainsi que sa répartition à la surface de la planète y sont également exposées. Le contexte actuel dans lequel cette nouvelle forme d'énergie doit trouver sa place est présenté et des perspectives d'avenir sont examinées.

B. Dessus et F. Pharabod (1996). Presses Universitaires de France, 108 boulevard Saint-Germain, 75006 Paris, France. Poche, 127p. ISBN 2-13-047824-7.

Vie et Nature

Ce magazine publié par l'Agence nationale pour la conservation de la nature (Algérie) est destiné aussi bien au grand public qu'aux lecteurs spécialisés. Sa vocation est de sensibiliser le citoyen à la nécessité de conserver la nature et d'utiliser ses ressources de manière durable.

Agence nationale pour la conservation de la nature, Jardin d'Essai El Anasser, Alger, Algérie. Tél : +213 (02) 67 40 69, Fax : +231 (02) 67 43 69. Périodique. ISSN 111-4967.

L'enquête publique : guide pratique

L'enquête publique issue de la loi n° 83-630 du 12 juillet 1983 et de ses textes d'application est conçue comme un instrument de défense de l'environnement au service de la démocratie locale.

Une nouvelle philosophie de l'enquête publique, un effort d'harmonisation et de simplification des procédures, une redéfinition du statut et du rôle du commissaire-enquêteur ont été les orientations majeures de la réforme.

Celles-ci ont reçu leur traduction juridique dans un corps de règles dont la bonne connaissance par les différents acteurs de la réforme, et notamment les commissaires-enquêteurs et les services administratifs chargés de les mettre en oeuvre, conditionne largement le succès de la nouvelle procédure.

Avec les nouvelles dispositions de la loi du 2 février 1995 qui renforcent le rôle des commissaires-enquêteurs, ce guide édité par le Ministère de l'Environnement vient à son heure rappeler les réformes accomplies.

Ministère de l'Environnement, Direction de la nature et des paysages, Sous-direction de l'aménagement et des paysages, 20 avenue de Ségur, 75302 Paris 07 SP, France. Tél : +33 (01) 42 19 20 21.

◆

Dear Mme. Aloisi de Larderel,

I write to heartily congratulate you and your team for the magnificent efforts you have made in producing the excellent UNEP publication "The Construction Industry and the Environment". The material has been carefully selected and produced with care and imagination.

We are arranging to circulate copies to all of our 30 national member federations, recommending that they each keep a copy in their libraries as a first class reference on the subject. Hopefully a significant number of additional copies will also be ordered through the national federations. We also intend sending copies to interested members of the European Parliament, the European Commission and European federations in the construction sector.

We are also very pleased that you were able to include a FIEC article prepared by Mr Guus Pieters and really wish that we could have contributed more extensively to this excellent work.

Beyond Europe's shores it is also pertinent to recall the role of the Confederation of International Contractors Associations (CICA) and your initial contacts with CICA's Secretary-General, Mr Eric Lepage. He, I know, is as impressed as we are and will, in turn, ensure that this publication finds its way into the construction federations across all six continents.

The publication "Construction Industry and the Environment" does credit to UNEP and is one of which your department may be justly proud. By the same token, UNEP has done our industry a service for which it has every reason to be grateful.

Yours very sincerely,
John Goodall
European Construction Industry Federation

The author of the article "APO's efforts for sustainable development of the environment" featured in volume 19, N° 3 has written to us to point out an error. We wrongly included the "People's Republic of China" in the sentence listing APO member governments (page 40, second column). This should have read "Taiwan". We apologize for this error and any confusion it may have caused.

UNEP Industry & Environment centre goes on-line by opening its home page to the public

UNEP's Industry and Environment centre, located in Paris, France, has opened a new service on the Internet's World Wide Web (WWW) that provides governments, industry, NGOs and other stakeholders with information about UNEP's initiatives in sustainable production and consumption. Anyone in the world who has access to the WWW can visit the home page by pointing their browser software to **http://www.unepie.org**.

This site is part of UNEP IE's continuing initiative to encourage and support the adoption of environmentally sound technologies and environmental management methods through worldwide information exchange.

The home page provides information about:

- UNEP IE's mission and activities
- Cleaner Production, including an on-line case study data base
- Awareness and Preparedness for Emergencies at the Local Level (APELL)
- Tourism and the Environment
- UNEP IE publications, including extracts from the quarterly *Industry and Environment* review
- Industrial Outreach
- Environmental Technology Assessment (EnTA)
- Industrial Pollution Management
- the OzonAction Programme, under the Multilateral Fund (including links to that home page)

As this site is an integral part of the UNEP WWW system, it also contains links to the home pages of UNEP headquarters and other UNEP sites around the world.

This home page is a natural extension of UNEP IE's ongoing information exchange activities, which have historically centred around the communication media accessible to developing countries: hardcopy publications and diskette data bases. Given the recent rapid expansion of Internet accessibility throughout the world, many industries and governments in developing countries now prefer the WWW and E-mail for communication. In accordance with the UNEP-wide initiative to make environmental information more readily available to a greater number of stakeholders through the WWW, UNEP IE is meeting this need.

The contents and features of this site will evolve over time to incorporate new information and to address user feedback.

For those organizations that maintain their own Web sites, we encourage you to add the following description and URL to link your page to our site:

UNEP Industry and Environment centre
http://www.unepie.org

This site provides information about UNEP IE's major activities and initiatives: prevention of industrial accidents and minimization of their impacts; environmental management and pollution control; environmentally sustainable tourism; preventive strategies for cleaner and more efficient production; environmental technology assessment; outreach to industry to stimulate dialogue and initiatives on sustainable development; and protection of the stratospheric ozone layer.

About UNEP Industry and Environment

UNEP established its Industry and Environment centre (UNEP IE) in 1975 to bring industry and government together to promote environmentally sound industrial development. UNEP IE is located in Paris. Its goals are: 1) to encourage the incorporation of environmental criteria in industrial development plans; 2) to facilitate the implementation of procedures and principles for the protection of the environment; 3) to promote preventive environmental protection through cleaner production and other pro-active approaches; 4) to stimulate the exchange of information and experience throughout the world. UNEP IE provides access to practical information and develops cooperative activities backed by regular follow-up and assessment. To promote the transfer of information and the sharing of knowledge and experience, IE has developed three complementary tools: technical reports; the quarterly *Industry and Environment* review; and a technical query-response service.

THE ROLE OF UNEP INDUSTRY AND ENVIRONMENT

It is now widely accepted that sustainable development and a sound environment go hand-in-hand. UNEP recognized this as early as 1975 when it established the Industry and Environment centre (IE), located in Paris. UNEP IE functions as a catalyst to bring industry, government and non-governmental organizations together to work towards environmentally sound forms of industrial development. UNEP IE seeks to:

- define and encourage the incorporation of environmental criteria in industrial development;
- help formulate policies and strategies for sustainable industrial development and facilitate their implementation;
- promote preventive environmental protection through cleaner production and other pro-active approaches; and
- stimulate the exchange of information on environmentally sound forms of industrial development.

To achieve these goals, UNEP IE has developed programmes in the fields of Awareness and Preparedness for Emergencies at Local Level (APELL), Cleaner Production, Tourism, Energy, and other sector-specific activities. The OzonAction Programme, under the Multilateral Fund, is also based at UNEP IE. UNEP IE organizes conferences and seminars, undertakes training activities and demonstration projects, and produces practical supporting publications.

To promote the transfer of information and experience, UNEP IE has developed:

- The *Industry and Environment* quarterly review;
- A *Query-Response Service*, which responds to specific technical queries on a wide range of subjects related to industrial pollution;
- *Outreach Activities*, which address a broad range of issues concerning industry as a whole. UNEP IE develops partnerships with industry, government and non-governmental organizations, organizes consultative meetings, and publishes supporting documents aimed at spreading new developments in the field of sustainable development.
- A *Technical Report Series* and other publications, which provide practical information to readers throughout the world. Recent titles include *Cleaner Production Worldwide, Hazards Identification in the Local Community, From Regulations to Industry Compliance: Building Institutional Capabilities, Audit and Reduction Manual for Industrial Emissions and Wastes, Companies Organization, and Public Communication on Environmental Issues*, and many others. For a complete list of available publications, please contact UNEP IE.

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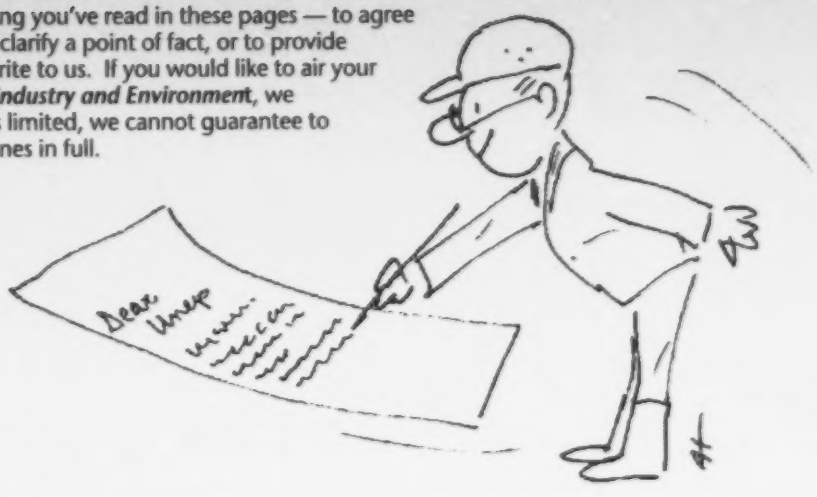
E-MAIL : unepie@unep.fr

FEEDBACK

If you would like to respond to something you've read in these pages — to agree or to take issue with a point of view, to clarify a point of fact, or to provide information on a particular aspect — write to us. If you would like to air your views on any other subject relevant to ***Industry and Environment***, we would like to hear from you. As space is limited, we cannot guarantee to publish all letters, nor to publish long ones in full.

Send your Feedback letters to:

Feedback
Industry and Environment Review
UNEP IE
Tour Mirabeau
39-43, quai André-Citroën
75739 Paris Cedex 15, France



Industry and Environment Review

a publication of the United Nations Environment Programme
Industry and Environment – UNEP IE

For more than fifteen years, the ***Industry and Environment*** quarterly review has provided a forum for the exchange of research and experience, presenting articles written by and for industry managers, government officials and researchers in the field of sustainable industrial development. In addition to features, news and developments of broad international interest, each issue of the review focuses on a particular theme. Recent issues have covered such varied topics as climate change and industry, education and training, managing contaminated land, transport, and sustainable tourism development. For a complete list of past issues and their availability, contact UNEP IE.

The next issue of ***Industry and Environment*** will focus on the theme of product design and the environment.

While ***Industry and Environment*** is an English language publication, it also includes articles in French and Spanish. All contributed articles are accompanied by summaries in English, French and Spanish.

环境署

The review is now also available in Chinese translation. For further details, please contact: Professor Chen Dingmao, Research Center for Eco-Environmental Sciences, Academia Sinica, P.O. Box 2871, Beijing 100085, China.

INDUSTRY AND ENVIRONMENT SUPPLEMENTS

The ***Industry and Environment*** review includes three semi-annual supplements, the *APELL*, *Cleaner Production* and *EnTA* newsletters.

UNEP IE's APELL programme – Awareness and Preparedness for Emergencies at Local Level – seeks to minimize the occurrence and impact of industrial accidents. This newsletter keeps readers up-to-date on APELL programmes currently in progress around the world.

Cleaner Production

The Cleaner Production newsletter provides information on cleaner technologies and products, actions by governments and organizations to promote cleaner production, and the UNEP IE Cleaner Production activities and network.

EnTA

The EnTA newsletter reports on technology assessment as a tool to develop environmentally sound technologies and to discourage the export of those that pose potential environmental hazards.

INDUSTRY AND ENVIRONMENT
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